

Evita 2 dura

Intensive Care Ventilator

Operating Instructions
Software 4.n





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Working with these Operating Instructions

Header line – the title... of the main chapter

The title of the respective sub-section is printed underneath the main header – to help you find your way quickly from subject to subject.

Page body... the Operating Instructions

combine text and illustrations. The information is presented in the form of required steps of action, giving the user hands-on experience in learning how to use the ventilator.

Left-hand column... the text

provides explanations and instructs users step-by-step in the practical use of the product, with short, clear instructions in easy-to-follow sequences.

Bullet points indicate separate actions. Where several actions are described, numbers are used to refer both to relevant details in the illustrations and to specify the sequence of actions.

Right-hand column... the illustrations

provide the visual reference for the text and make it easier to locate the various parts of the equipment. Elements mentioned in the text are highlighted. Unnecessary details are omitted.

Rendering of screen displays guide the user and allow to reconfirm actions performed.

Typing conventions...

Controls are designated as »Control Name«, e.g:

»PEEP«

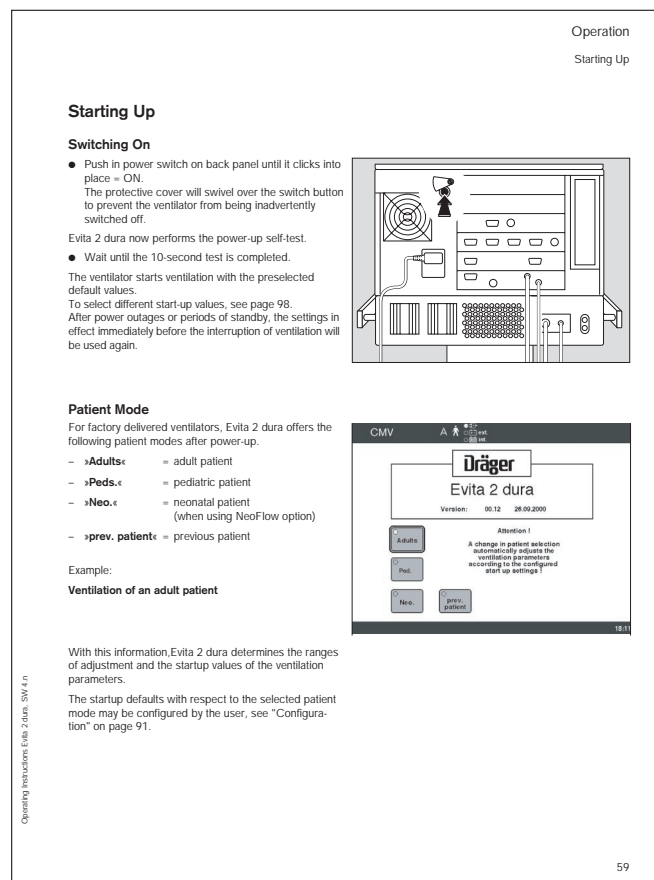
Screen pages are indicated as »Screen page«, e.g.

»Measured values«

Screen messages are printed in bold, e.g:

!!! Flow sensor?

NOTE: If you wish to read these instructions without the ventilator in front of you, you may want to keep the full page photo folded out.



WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Use" (see page 22) and in conjunction with appropriate airway monitoring (see page 23). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

At a Glance – New Features of Evita 2 dura Software 4.n

Entering the humidifier type used

- »Heated (active) humidifier«
or
- »HME/filter« (artificial nose)
- for a more accurate measurement of volume parameters

Apnea ventilation On/Off

- now selectable as a startup configuration

Extended range for alarm delay time »T_{Apnea} - now adjustable in the range of 5 to 60 seconds (was 15 to 60 seconds)

Breath rate adjustable down to 0

- for smooth weaning in PCV*+ (BIPAP) and SIMV

Ventilation mode PCV[®]+Assist (BIPAP_{Assist})

- for pressure controlled, assisted ventilation

Choice of patient mode »prev. patient«

- for using previously configured settings in effect before ventilator was switched off

Leak compensation On/Off

- for switching automatic leak compensation on or off

Monitoring of obstructed tube

- with new warning message
!!! Tube obstructed

Additional weaning parameter

available as SW 4.n plus upgrade

In addition to the parameter occlusion pressure P 0.1, Evita determines the parameters

- RSB Rapid Shallow Breathing Index
and
- NIF Negative Inspiratory Force Index
- f_{spn} and MV_{spn} as trend

External flow source

available as SW 4.n plus upgrade

- Evita 2 dura.4.n calculates the contribution of external flow and adjusts volume monitoring thresholds to avoid nuisance alarms.

Evita Remote (Remote Pad)

available as an option

- remote control for parallel use of Evita 2 dura function keys

Nurse call

available as an option

- connection for transmitting alarm messages to a central alarm station

Simplified settings

in "Other Modes"

* PCV is a registered trademark of Dräger

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Important Safety Information

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Operator's Responsibility for Patient Safety

For correct and effective use of the product and in order to avoid hazards, it is mandatory to carefully read and to observe all portions of this manual.

The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, largely to the specifics of the Dräger design. This publication excludes references to various hazards which are obvious to a medical professional and operator of this equipment, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions.

Product modification or misuse can be dangerous.

Draeger Medical, Inc. disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this product with other products whether supplied by Dräger or by other manufacturers if such a combination is not endorsed by Draeger Medical, Inc.

The operators of the ventilator system must recognize their responsibility for choosing appropriate safety monitoring that supplies adequate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of different means ranging from electronic surveillance of equipment performance and patient condition to simple, direct observation of clinical signs. The responsibility for the selection of the best level of patient monitoring lies solely with the equipment operator. (See also page 23, "Mandatory Ventilation Monitoring").

Limitation of Liability

Draeger Medical, Inc.'s liability, whether arising out of or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Draeger Medical, Inc.'s Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Draeger Medical, Inc. and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

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Draeger Medical, Inc. shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

Warranty

All Dräger products are guaranteed to be free of defects for a period of one year from date of delivery. The following are exceptions to this warranty:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Draeger Medical, Inc. or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.
3. Oxygen sensors capsules have a 12 month limited warranty from the date of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Draeger Medical, Inc. holding the option. Draeger Medical, Inc. is not responsible for deterioration, wear, or abuse. In any case, Draeger Medical, Inc. will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. Draeger Medical, Inc. or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.
2. Defective material or equipment must be returned, shipping prepaid, to Dräger or its authorized representative.
3. Examination by Draeger Medical, Inc. or its authorized representative must confirm that the defect is covered by the terms of this warranty.
4. Notification in writing of defective material or equipment must be received by Draeger Medical, Inc. or its authorized representative no later than two (2) weeks following expiration of this warranty.

The above is the sole warranty provided by Draeger Medical, Inc. No other warranty expressed or implied is intended. Representatives of Dräger are not authorized to modify the terms of this warranty.

Draeger Medical, Inc., Telford, PA

Definitions

WARNING !

A **WARNING** statement refers to conditions with a possibility of personal injury if disregarded.

CAUTION !

A **CAUTION** statement designates the possibility of damage to equipment if disregarded.

NOTE: A **NOTE** provides additional information intended to avoid inconveniences during operation.

Inspection	= examination of actual condition
Service	= measures to maintain specified condition
Repair	= measures to restore specified condition
Maintenance	= inspection, service, and repair, where necessary
Preventive Maintenance	= Maintenance measures at regular intervals

Typing conventions in this manual

Controls (hard keys and menu / screen keys) are designated as »**Control Name**«, e.g.

»**Configuration**«

Screen pages are indicated as »Screen page«, e.g.

»Measured values«

On-screen messages are printed in **bold**, e.g.

!!! **Flow sensor?**

Summary of WARNINGS and CAUTIONS

WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Medical Applications" (see page 22) and in conjunction with appropriate airway monitoring (see page 23). Observe all **WARNINGS** and **CAUTIONS** as rendered throughout this manual and on labels on the equipment.

WARNING !

The Evita 2 dura ventilator must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

WARNING !

DANGER, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

Precautions During Preparation

WARNING !

Do not use wireless or cellular phones within 33 feet (10 m) of the equipment.

Radio communication devices may cause malfunction in electromedical equipment.

WARNING !

Always install expiratory valve that has been cleaned and disinfected.

WARNING !

Do not use ventilator in conjunction with nuclear spin tomography (MRT, NMR, or NMI)!

Equipment malfunction may result.

WARNING !

Treatment of batteries and O₂-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

WARNING !

Dräger cannot warrant or endorse the safe performance of heat/moisture exchangers.

The user has to verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees its complete suitability for its intended use.

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O₂ concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.

WARNING !

The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.

CAUTION !

Restriction of Distribution

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician.

WARNING !

Dräger cannot warrant or endorse the safe performance of third party humidifiers for use with the Evita 2 dura ventilator. Specifically, the user has to assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. It is strongly recommended to use the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/ distributors of third party humidifier devices about compliance of their products with the requested performance characteristics

WARNING !

Do not use a heat/moisture exchanger (HME) simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation

WARNING !

In order to avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits

WARNING !

It is strongly recommended to use the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

WARNING !

Connecting other devices to the same extension power strip may, in the event of grounding failure, cause the leakage current to the patient to increase beyond the permissible values.

In this case, the risk of electric shock cannot be safely excluded.

WARNING !

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.

WARNING !

Installation and activation of the Evita Remote kit should only be performed by DraegerService or factory trained and authorized personnel.

WARNING !

Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized personnel.

WARNING !

The operator of the ventilator must still assume full responsibility for ventilation monitoring via the Evita 2 dura screen when the nurse call is connected.

Only highest priority alarms (!!!) will activate the nurse call.

- Check screen displays frequently.

WARNING !

The ventilator is ready for operation only when:

- it is completely assembled with all required auxiliary equipment in place,
- all sensors are calibrated (O₂, Flow, CO₂)
- the »device check« has been completed successfully.

Precautions During Operation

CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

CAUTION !

Do not place containers of liquids on top of the Evita 2 dura ventilator. Liquids getting into the ventilator can cause equipment malfunction and damage.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O₂ concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.

WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O₂ concentrations <24 %.
- Always secure O₂ cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O₂ equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

WARNING !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO₂ according to the blood gas values measured.

WARNING !

Do not block air intake. Ventilator malfunction will result.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

WARNING !

The alarm silence key is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilation and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury

WARNING !

The integrated nebulizer function of Evita 2 dura is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause deviations in tidal volume and inspiratory O₂ concentration!

WARNING !

When using the nebulizer with breath rates below 12 bpm, deviations from set oxygen concentration can be significantly higher in extreme cases.

These deviations cannot be monitored by the internal O₂ analyzer of the ventilator.

WARNING !

Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)!

The measuring function of the flow sensor may be impaired.

The flow resistance of filters is liable to increase and may impair ventilation.

Do not put a microbial filter on the nebulizer outlet when in use!

WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation

WARNING !

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors after disinfection).

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

CAUTION !

Do not place containers of liquids (such as infusion bags or bottles) on top of or over the Evita 2 dura ventilator. Liquids getting into the ventilator can cause equipment malfunction and damage.

Precautions During Configuration

WARNING !

Configuration of ventilation modes and default parameters should only be performed by staff authorized by a hospital protocol.

Precautions During Care

WARNING !

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

WARNING !

Vent flow sensor after disinfection with ethanol for at least 30 minutes. Otherwise, residual ethanol vapors might ignite and destroy the sensor during calibration.

WARNING !

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

WARNING !

To avoid any risk of infection for hospital staff or other patients, clean and disinfect ventilator after use. Follow all accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

CAUTION !

Temperature sensor is not compatible with parts washer equipment or bath disinfection.

CAUTION !

Flow sensor is not compatible with parts washer equipment and may not be autoclaved.

CAUTION !

Do not disassemble expiratory valve beyond removing diaphragm!

CAUTION !

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized.

CAUTION !

Make sure that no liquid remains in the pressure measuring canal of the expiratory valve, since it might cause malfunction.

Precautions During Maintenance

WARNING !

To avoid any risk of infection, clean and disinfect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when returning ventilators or parts for repair.

WARNING !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained or factory authorized service personnel.

WARNING !

Treatment of batteries and O₂-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

CAUTION !

The device must be inspected and serviced at regular six months intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor.

For repairs and in any case of malfunction of the device we recommend that you contact DrägerService.

Intended Use

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Intended Medical Application

Evita 2 dura is a long term ventilator to be used in the intensive care of adults and children with a body weight of at least 3 kg.

Available Ventilation Modes

CMV	<p>Continuous Mandatory Ventilation, controlled and assisted constant volume ventilation.</p> <p>With the options:</p> <ul style="list-style-type: none"> – CPPV (Continuous Positive Pressure Ventilation) Controlled ventilation with continuous positive airway pressure – PLV (Pressure Limited Ventilation) Pressure limited, constant volume ventilation – AutoFlow[®] * (available option) for optimizing inspiratory flow – IRV (Inverse Ratio Ventilation) ventilation with I:E ratios exceeding 1:1
SIMV	<p>Synchronized Intermittent Mandatory Ventilation, procedure for weaning patients off the ventilator after they have started spontaneous breathing.</p> <p>With the options:</p> <ul style="list-style-type: none"> – PLV (Pressure Limited Ventilation) Pressure limited, constant volume ventilation – AutoFlow[®] * (available option) for optimizing inspiratory flow – IRV (Inverse Ratio Ventilation) ventilation with I:E ratios exceeding 1:1
MMV	<p>Mandatory Minute Volume Ventilation, spontaneous breathing with automatic adjustment of mandatory ventilation to the patient's minute volume requirement.</p> <p>With the options:</p> <ul style="list-style-type: none"> – PLV (Pressure Limited Ventilation) – AutoFlow[®] (available option) for optimizing inspiratory flow
CPAP	<p>Continuous Positive Airway Pressure, Spontaneous breathing with positive airway pressure.</p>

PSupp.	<p>Pressure Support, Pressure supported spontaneous breathing.</p>
PCV+	<p>Pressure Controlled Ventilation Plus, Pressure controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and with adjustable pressure increase to CPAP level.</p>
PCV+Assist	<p>Pressure Controlled Ventilation plus, Assisted (BIPAP^{**Assist}) Pressure controlled, assisted ventilation.</p>
APRV	<p>Airway Pressure Release Ventilation (available option), Spontaneous breathing on two pressure levels with long time ranges – independently adjustable.</p>

Special modes:

Apnea Ventilation	<p>For automatically switching over to volume controlled mandatory ventilation, if spontaneous breathing stops. If apnea occurs, Evita sounds an alarm after the preset alarm period (T_{apnea} /[°]) and starts volume controlled ventilation.</p>
ILV	<p>Independent Lung Ventilation (available option), Separate, differential, synchronized ventilation with one Evita 2 dura ventilator for each lung or with Evita 2 dura and another Evita ventilator, respectively.</p>

Respiratory diagnostic maneuvers:

Intrinsic PEEP measurement (available option)	<p>for determining intrinsic PEEP and measuring trapped volume.</p>
Occlusion pressure measurement (available option)	<p>for evaluating a patient's breathing drive during spontaneous breathing.</p>
Automatic gas switchover	<p>In the event of a failure of one of the supply gases, the changeover to the other gas is automatic.</p>

*AutoFlow is a registered trademark of Dräger

Mandatory Ventilation Monitoring

Evita 2 dura includes monitoring for:

- airway pressure, P_{aw}
- expiratory minute volume, MV
- inspiratory O₂ concentration, FiO₂
- inspiratory breathing gas temperature, T
- expiratory CO₂ concentration, etCO₂ (available option)
- inspiratory tidal volume, VTi
- apnea time
- tachypnea monitoring to detect rapid, shallow spontaneous breathing

Changes in these parameters may be caused by:

- acute changes in the patient's condition
- incorrect settings and improper handling
- equipment malfunctions
- failure of power and gas supplies

In case of a fault in the integrated monitoring equipment, independent measuring instruments (such as a patient monitor, oxygen analyzer, breathing gas temperature monitor, etc.) must be used.

WARNING !

In case of malfunction of any of the built-in monitoring, a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

Back-up Ventilation With an Independent Manual Ventilation Device (Resuscitation Bag)

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O₂ concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.

Restrictions of Use

WARNING !

The Evita 2 dura ventilator must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction

WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

WARNING !

DANGER, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

WARNING !

Do not use wireless or cellular phones within 33 feet (10 m) of the equipment.

Radio communication devices may cause malfunction in electromedical equipment¹⁾.

WARNING !

Do not use ventilator in conjunction with nuclear spin tomography (MRT, NMR, or NMI)! Equipment malfunction may result.

1) Draeger medical devices comply with the interference immunity requirements of the specific standards for the products or EN 60601-1-2 (IEC 601-1-2). However, depending on the design of the mobile phone and situation of use, field strengths may occur in the immediate environment of a mobile phone that exceed the limits of the standards quoted and therefore cause interference.

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Operating Concept

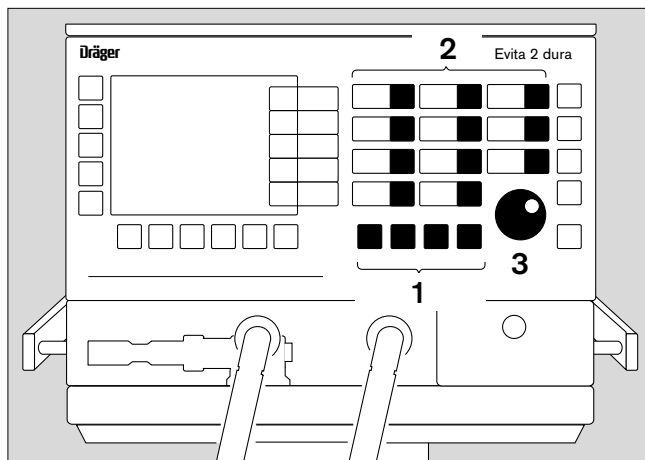
Contents

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Ventilator Controls

Controls Related to Ventilation

- 1 Keys for selecting modes of ventilation:
 - **CMV**
 - **SIMV**
 - **PCV+**
 - as well as
 - **other modes**
- 2 Keys for selecting/adjusting ventilation parameters:
 - Tidal volume **VT**
 - Inspiratory time **T_{insp}**
 - Breath rate (frequency) **f**
 - Inspiratory flow **Flow**
 - Inspiratory pressure Δ **P_{insp}**
 - Pressure support **P_{supp}**
 - Oxygen concentration **O₂**
 - Positive end-expiratory pressure **PEEP**
 - Pressure rise time **Slope**
 - Trigger sensitivity **Trigger**
- 3 Central "turn-and -push" dial knob for adjusting parameters:
Turn dial knob to set,
press dial knob to confirm.



Setting ventilation parameters

- 2 To select a ventilation parameter for setting, press corresponding parameter key.
The yellow LED in the key lights up.
- 3 To set value of the ventilation parameter, turn dial knob. Values are displayed next to the parameter key.
- 3 To confirm the value, press dial knob.
The yellow LED is now off.








Selecting modes of ventilation

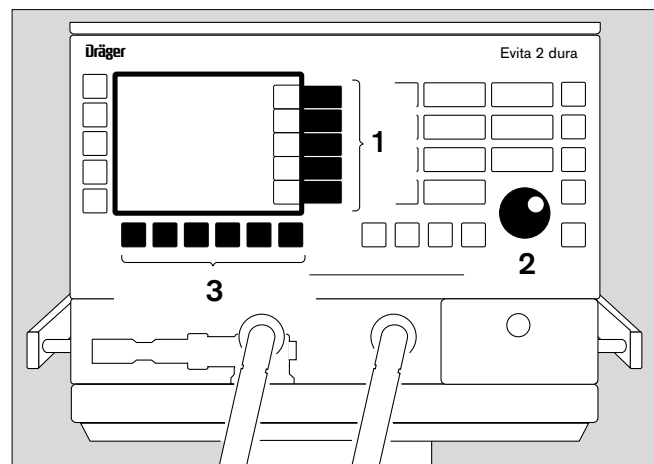
- 1 Hold down respective key for about 3 seconds.
or
press respective key briefly and press dial knob to confirm.

The selected ventilation mode will now be active.







For detailed instructions on setting ventilation modes, see page 62 and following.

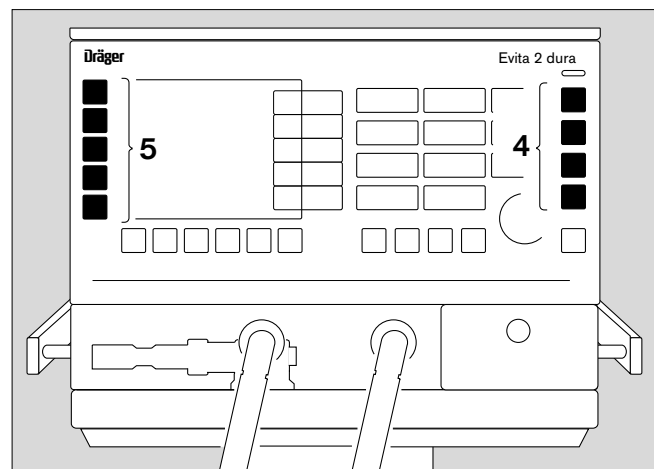
Controls for Screen Functions

- 1 Menu selection keys for operating screen menus.
- 2 Central "turn-and-push" dial knob for selecting and setting options displayed on the screen.
To select/set, turn dial knob
To confirm, press dial knob.
- 3 Screen operating keys:
 - » **Printer**  « key for manual printer logging,
 - »  /  « key for setting the screen backlighting to bright or dark,
 - » **Freeze**  « key for freezing waveforms,
 - » **Waves**  « key for displaying a different pair of waveforms,
 - » **Values**   « key for displaying a different combination of measured values,
 - a key reserved for functions to be added in the future.



Keys for Routine and Auxiliary Functions

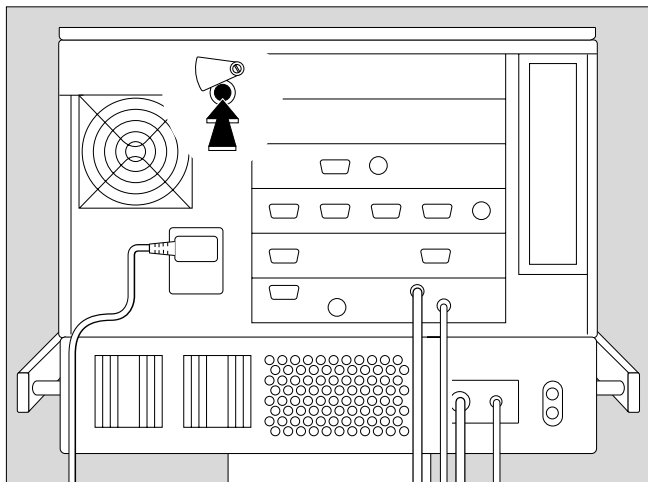
- 4 Frequently used keys for routine functions are positioned on the right-hand side of the front panel:
 - »  « key for silencing audible alarms,
 - » **Alarm Reset**  « key for resetting or acknowledging alarm messages,
 - »  « key for calling up information and help on ventilator settings.
 - »  « key for protecting against inadvertent or unauthorized modification of settings of ventilation parameters or modes of ventilation.
- 5 Keys for auxiliary functions are positioned on the left hand side of the front panel:
 - »  « key for switching nebulizer on/off,
 - » **O₂ ↑ Suction**  « key for pre/post oxygenation during bronchial suction and automatic alarm silence
 - » **Insp. hold** « for manually activated inspiration,
 - » **Exp. hold** « for extending the expiratory time,
 - a key reserved for functions to be added in the future.



Power Switch

for switching the ventilator on and off.

The power switch is located at the rear of the ventilator and has a pivoting cover to protect against inadvertently switching off the ventilator.



»Standby« Key

Located separately, away from other keys.

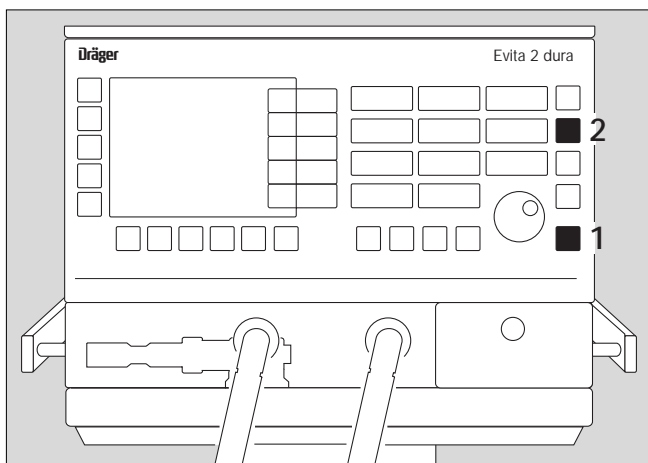
For keeping ventilator in standby
or
for switching on ventilation.

To switch to standby:

- 1 Press and hold down »**Standby**« key for at least 3 seconds.
- 2 Confirm with Alarm Reset Button.

To switch on ventilation:

- 1 Briefly press and release »**Standby**« key.



Screen Pages

All screen pages are based on two general layouts:

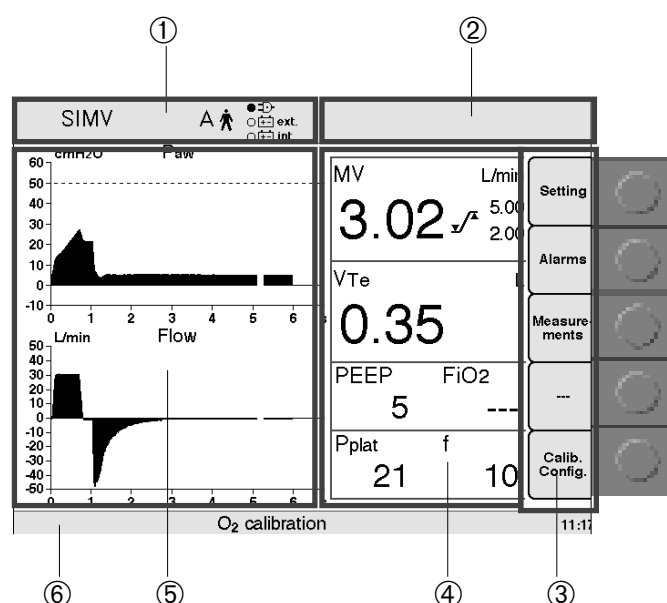
- a main page, displaying all important ventilation characteristics at a glance
- and
- the application-specific pages for functions and settings.

Important functions are displayed in the same location in both screen layouts:

- active ventilation mode and patient mode
- alarms and advisory messages
- labels for the menu selection keys
- information and help.

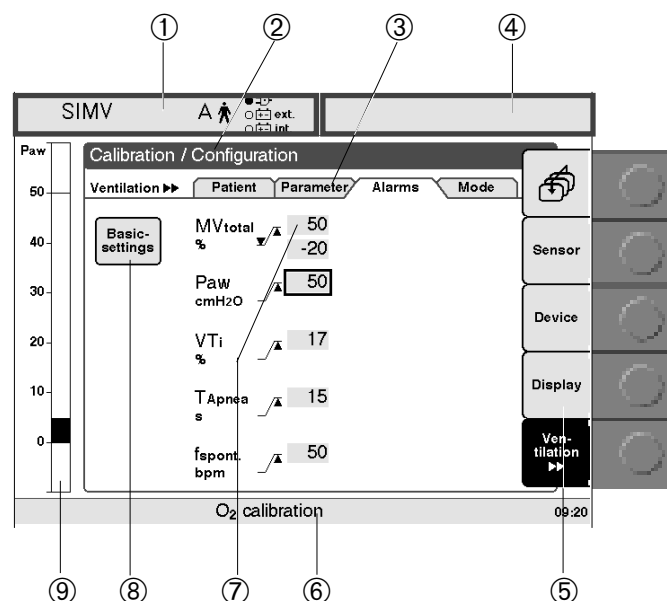
Main page layout

- ① Status bar showing the currently active ventilation mode, patient mode and power source
- ② Status bar for alarms and advisory messages
- ③ Field for menu selection key labels
- ④ Field for measured values
- ⑤ Field for waveforms
- ⑥ Screen bar for information and help



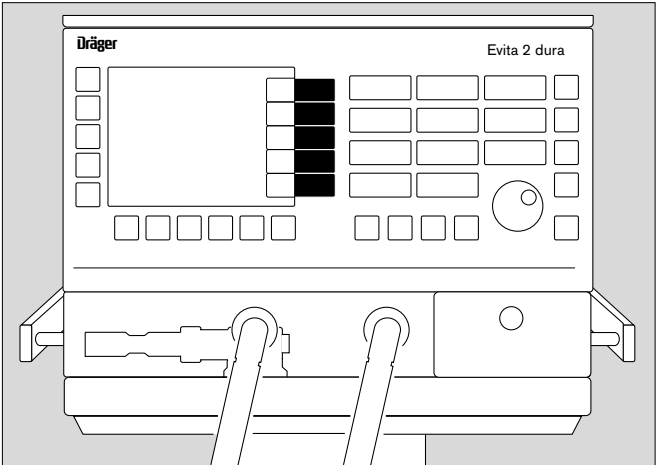
Layout of the application-specific pages

- ① Status bar showing the currently active ventilation mode, patient mode and power source
- ② Field for displaying the selected menu
- ③ Menu bar
- ④ Status bar for alarms and advisory messages
- ⑤ Field for menu key labels
- ⑥ Screen bar for information and help
- ⑦ Screen key, selectable with "turn-and-push" dial knob
- ⑧ Screen value, selectable with dial knob
- ⑨ Field for continuous display and monitoring of pressure



The menu keys along the right-hand edge of the screen select application screen pages for the following specific situations:

- **Additional Settings**
- **Alarms**
- **Measured values**
- **Measuring maneuvers** (available option)
- **Calib./Config.**



»Additional Settings«

- For setting apnea backup ventilation parameters
- For setting intermittent PEEP (sigh) in CMV

Please refer to chapter "Setting ventilation modes", starting on page 62, for detailed instructions on settings.

»Alarms«

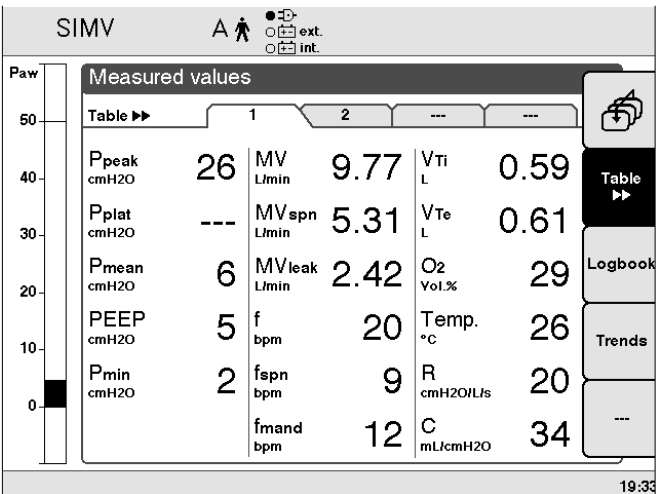
- For displaying measured values with their alarm limits.
- For setting alarm limits.

See "Setting alarm limits" on page 73 for detailed instructions on settings.

»Measured values«

- For displaying all measured values in the current ventilation mode.

Selecting »Table ►« screen key and confirming with dial knob displays values measured by installed options on screen »Table 2«.



»Calibration/Configuration«

The following functions are performed within this screen:

Sensors

- Calibrating sensors for O₂ and flow
- Switching monitoring functions on and off

Ventilator

- Adjusting audible alarm volume
- Adjusting screen contrast
- Setting date and time
- Selecting language and units of measurement
- Configuring external interfaces

Monitoring

- Selecting 2 sets of 6 measured values from the main page
- Selecting 2 sets of 2 waveforms from the main page

Default settings (at start up)

- Patient mode
- Ventilation mode
- Ventilation parameters
- Alarm limits

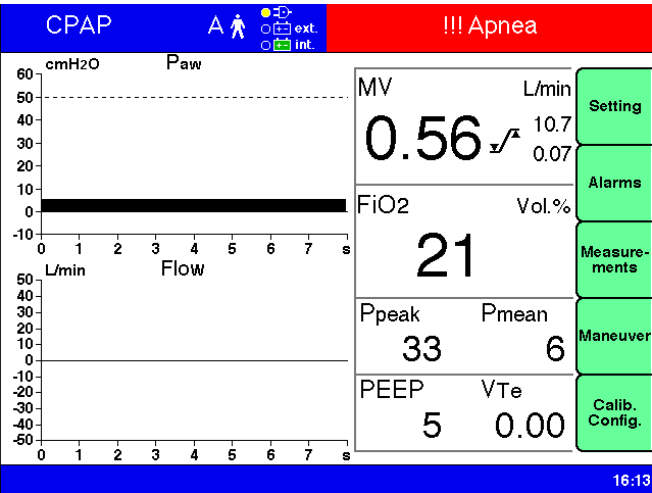
Color Screen (Available Option)

To support on-screen information by representation in color.

For alarm messages

- red = Warning level alarm
- yellow = Caution or Advisory level alarm
- blue = inactive alarm

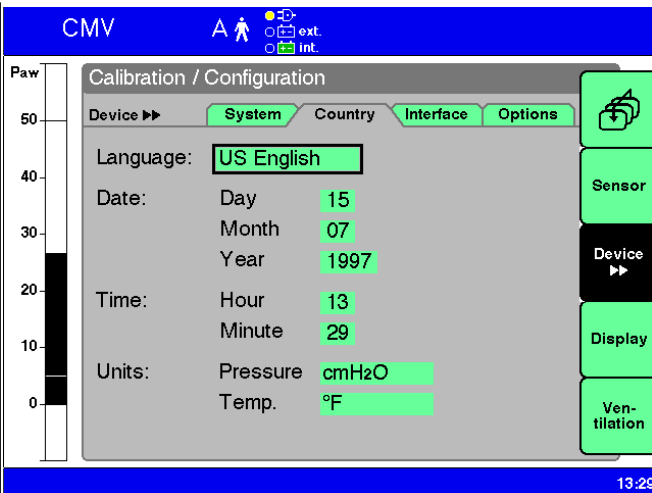
Example: Alarm "Apnea !!!"



For menu keys:

- green = selectable
- black = selected

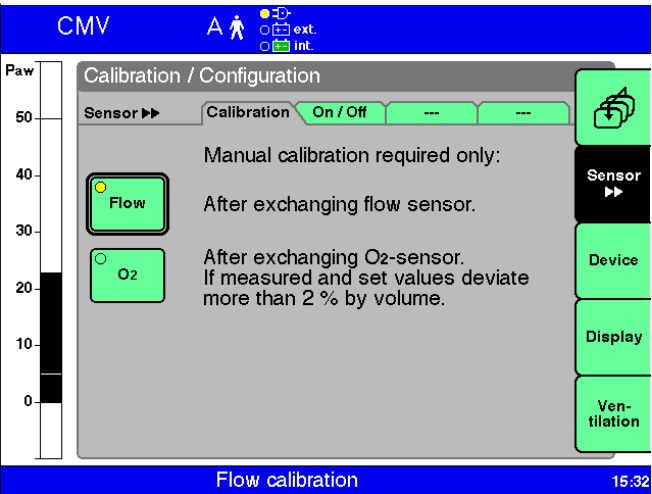
Example: »Ventilator» menu key



For screen keys:

- green "LED" in a screen key = function not active
- yellow "LED" in a screen key = function active

Example: screen key »Flow« – function active



Preparation

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Assembly of Components

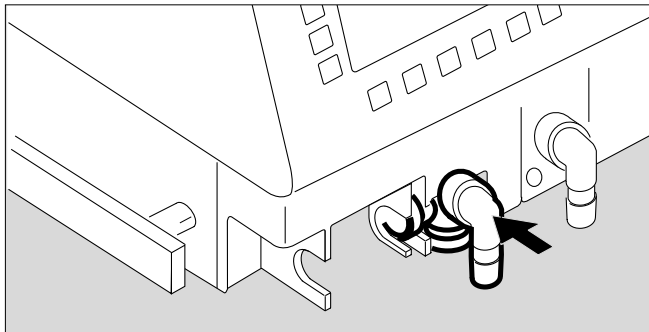
Installing the Expiratory Valve

WARNING !

Always install expiratory valve that has been cleaned and disinfected.

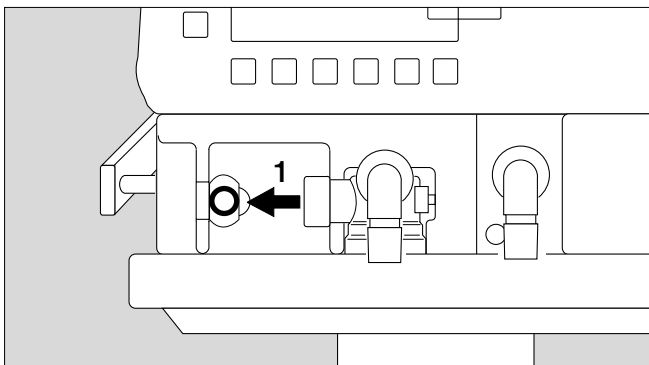
NOTE: Refer to page 112 for re-assembly of a disassembled expiratory valve.

- Push patient block fully into mounting receptacle. Check that it is properly engaged by gently pulling on the port. It should stay securely attached.



Mounting a Flow Sensor

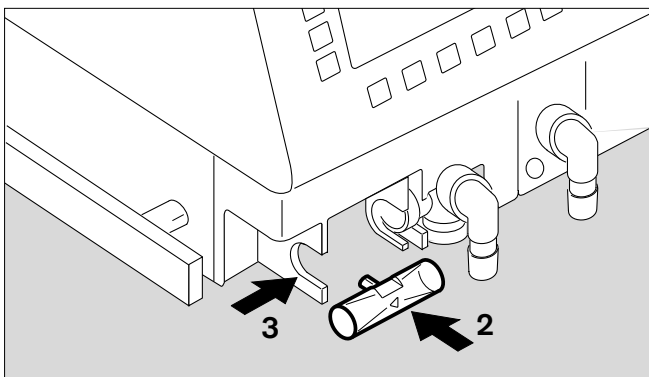
- 1 Push connector socket all the way to the left



- 2 Gently push flow sensor into its mount – with the connector facing towards the ventilator – and into the socket as far as it will go.

Then:

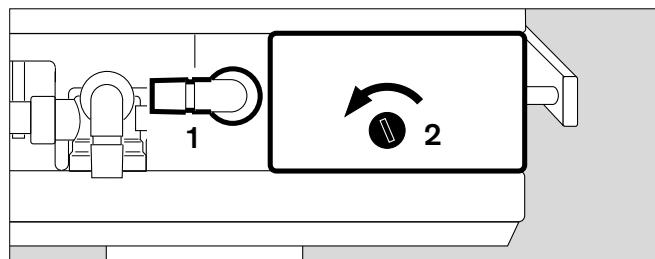
- 3 Push flow sensor to the right and into the rubber lip seal of the expiratory valve as far as it will go.



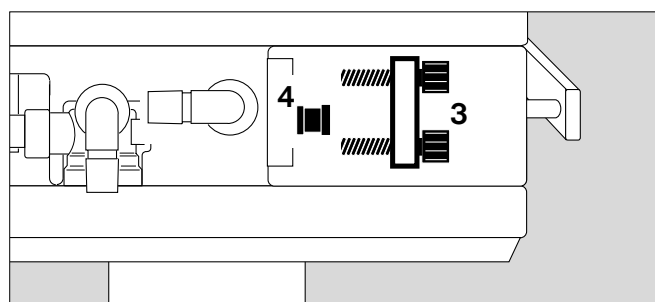
Installing an O₂ Sensor Capsule

- when using the system for the first time
- when the display reads:
O₂ measurement inop
- when calibration can no longer be performed.

- 1 Turn port downwards or to the left.
- 2 Use coin to loosen screw and remove protective cover.



- 3 Loosen the two knurled screws and open sensor chamber.
 - 4 Insert new sensor capsule.
- NOTE:** The sensor end with the circular contacts must be visible.
- Close sensor chamber securely with the two knurled screws.
 - Screw protective cover back in place.



CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

After installation:

- Wait for 15 minutes warm up of sensor before it can be calibrated
- Calibrate sensor manually, see page 86.
- Dispose of the used sensor, see page 114.

WARNING !

Treatment of batteries and O₂-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

Precautions When Using Heat/Moisture Exchangers

The use of a heat/moisture exchanger (HME, artificial nose) in the patient connection can increase breathing resistance considerably.

An increase in breathing resistance will lead to increased work of spontaneous breathing and will require a greater trigger effort during assisted ventilation. Under unfavorable conditions, an increase in breathing resistance can also lead to inadvertent PEEP.

The operator must be aware that this breathing resistance in the patient circuit cannot be monitored by the ventilator.

- Therefore you should regularly check the condition of the patient and the ventilator's measured values for volume and resistance more frequently.
- Carefully observe instructions for use of the heat/moisture exchanger (HME)!

WARNING !

Dräger cannot warrant or endorse the safe performance of heat/moisture exchangers.

The user has to verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees its complete suitability for its intended use.

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation

Potential Hazards from Use of Expiratory Bacteria Filters

The use of an expiratory bacteria filter is not mandatory.

Use of bacteria filters in the expiratory side of the patient circuit can cause an undesirable increase in breathing resistance.

Particularly when nebulizing aerosols or humidifying the breathing gas, resistance caused by a bacteria filter may slowly increase, leading to increased work of breathing and to intrinsic PEEP.

WARNING !

The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.

Intrinsic PEEP may be recognized by the fact that expiratory flow has not returned to "0" at the end of expiration.

In case of unacceptably high PEEP, the ventilator will issue the alarm message:

PEEP high

- Check bacteria filter and exchange, if it proves to be the cause of high PEEP.

Inspiratory and expiratory resistance in the patient circuit can be determined in Standby mode before the begin of ventilation using the ventilator check procedure, see page 54.

Installing a Heated Humidifier

WARNING !

Dräger cannot warrant or endorse the safe performance of third party humidifiers for use with the Evita 2 dura ventilator. Specifically, the user has to assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. It is strongly recommended to use the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/ distributors of third party humidifier devices about compliance of their products with the requested performance characteristics.

- 1 Attach humidifier to mount below ventilator with rail clamp and secure clamp mechanism (screws, lever).
- 2 Swivel humidifier into desired position.
- Prepare humidifier following its Operating Instructions.

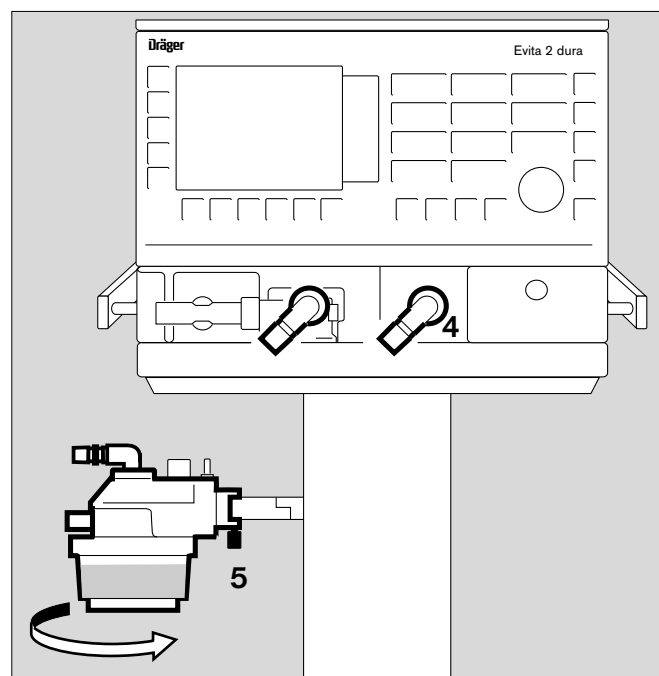
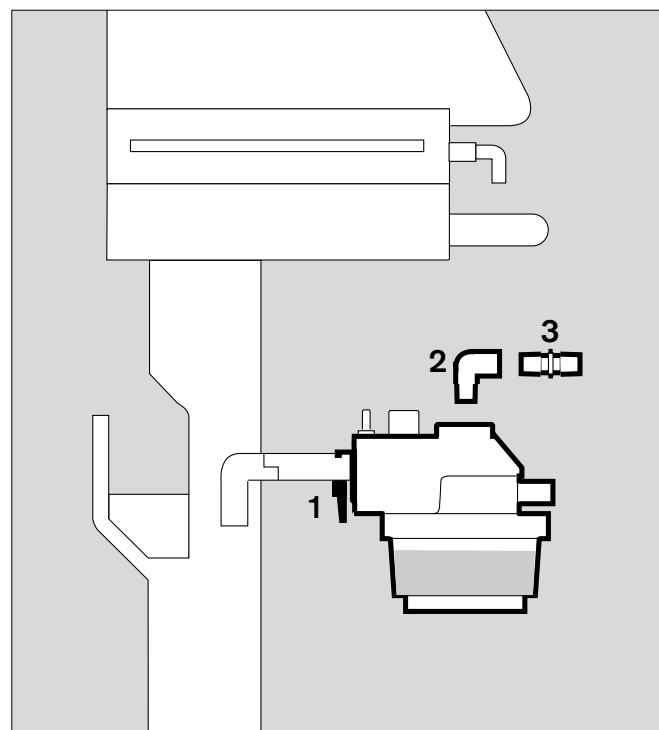
The hinged circuit support arm can be mounted to either side of the ventilator, depending on the desired position of the ventilator in relation to the patient bed.

- 3 Turn expiratory port to the left or right, respectively (left showing).
- 4 Attach angled circuit connector of humidifier pointing into the direction desired (left showing).
- 5 Turn inspiratory port to the right and install a bacteria filter to the port

NOTE: The following descriptions assumes that patient circuit has been attached on the **left-hand** side

CAUTION !

Do not place containers of liquids on top of the Evita 2 dura ventilator. Liquids getting into the ventilator can cause equipment malfunction and damage.



Ventilating Adults and Children

Upward from 100 mL – 2000 mL tidal volume V_T

Patient mode: »Adults«

WARNING !

Do not use a heat/moisture exchanger (HME) simultaneously with a nebulizer or heated humidifier!

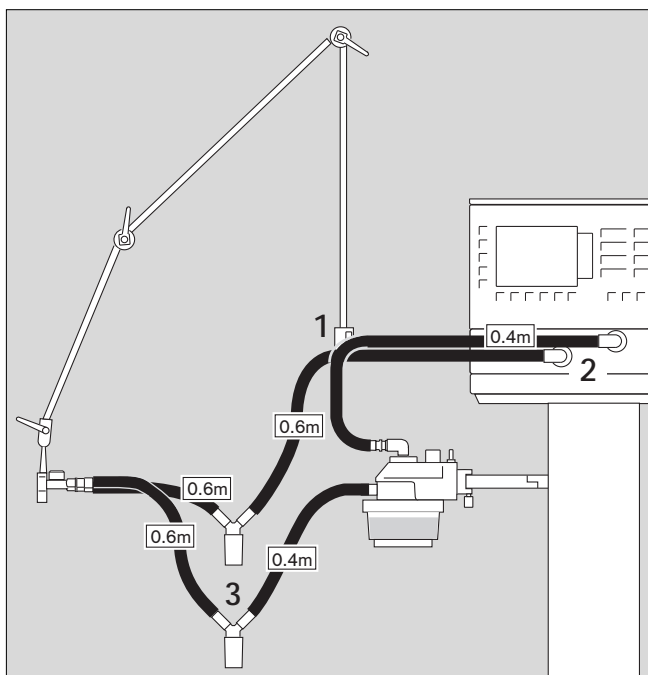
Risk of increased breathing resistance due to condensation

Connecting the Patient Circuit

WARNING !

In order to avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits*

- 1 Attach circuit support arm to the rail on the left-hand side of the ventilator and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- 2 Turn ports in direction of hoses.
- 3 Install water trap(s) in vertical position at the lowest point of the circuit.
- Connect Y-piece, with the rubber sleeve of the Y-piece on the inspiratory side (reusable silicone circuit).



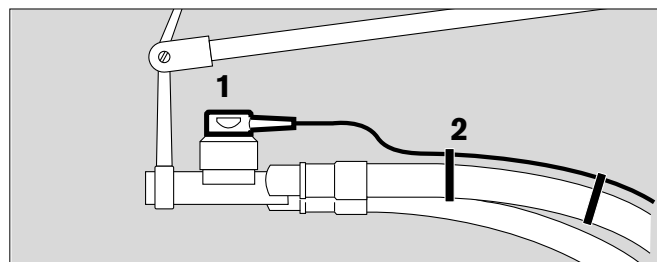
* **NOTE:** IEC 601-2-12 "Lung Ventilators" does not consider the use of antistatic or electrically conductive materials for patient circuits of a lung ventilator a contribution to increased safety. To the contrary, the use of such materials increases the risk of electric shock for the patient and the fire risk associated with oxygen.

Installing a Temperature Sensor

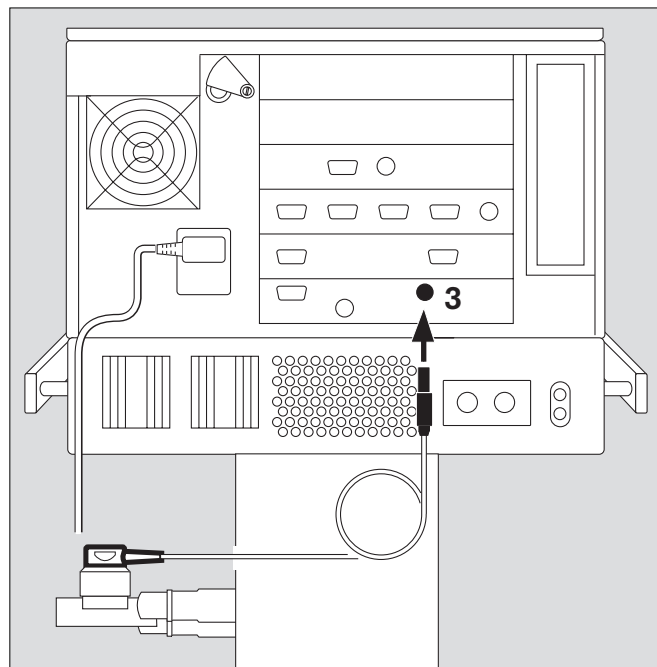
WARNING !

It is strongly recommended to use the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

- 1 Push sensor into the rubber sleeve on the inspiratory side of the Y-piece as far as it will go. Align Y-piece so that the sensor is at the top.
- 2 Attach sensor cable with hose clips.



- 3 Insert probe of the temperature sensor 8405371 into the socket at the rear of the unit.



Ventilating Infants

Up to 300 mL tidal volume V_T

Patient mode »Ped.«

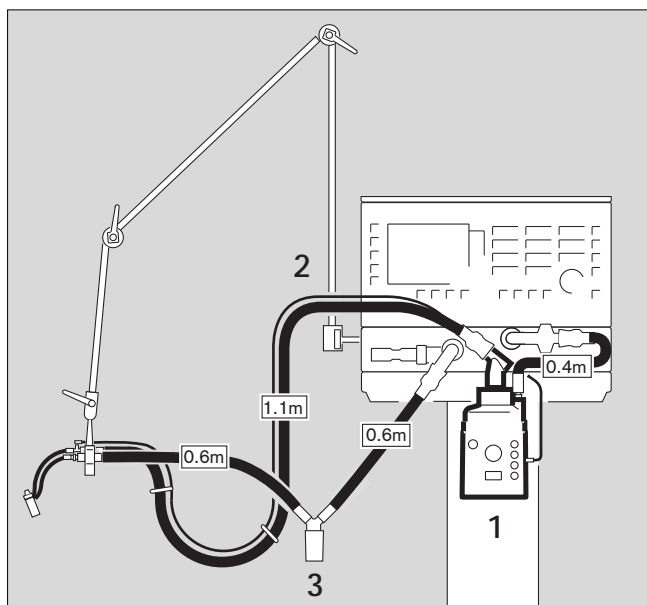
WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation

Installing an Infant Patient Circuit

- 1 Prepare the humidifier following its Operating Instructions, using infant size patient circuit connectors.
- 2 Clamp hinged circuit support arm to rail on the left-hand side and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- 3 Install water trap(s) in vertical position.



Supplies and Connections

Electrical Power Supply

Connect to line voltage of:

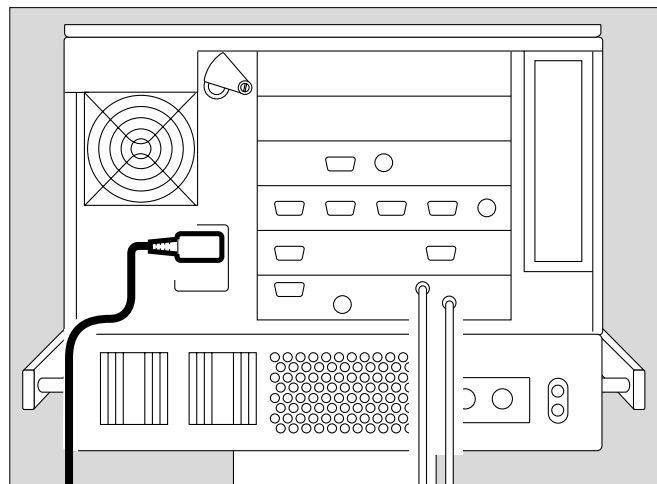
either : 220 V to 240 V
or : 100 V to 127 V

Evita 2 dura is equipped with an auto-switching power supply that adapts to the local line voltage.

- Insert plug into the power outlet.

WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.



For operation with DC power supply accessory "Integrated battery supply 12/24 V - Evita 4/Evita 2 dura DC", part no. 84 13 034, and additional battery (option)

either : 12 V
or : 24 V

- Follow Operating Instructions of "Evita 4 /Evita 2 dura DC"

Precautions When Using a Power Strip for Auxiliary Equipment

WARNING !

Connecting other devices to the same extension power strip may, in the event of grounding failure, cause the leakage current to the patient to increase beyond the permissible values.

In this case, the risk of electric shock cannot be safely excluded.

Temporary Interruption of Power Supply

e.g. when hospital backup power supply is activated.

Without the 12/24 V DC power supply option:

During an interruption of AC line power, Evita 2 dura sounds a continuous audible alarm for a maximum of 2 minutes.

If the ventilator was in use less than 15 minutes, this time may be shorter.

Evita 2 dura tolerates power interruptions shorter than 10 milliseconds – without any effect on ventilation.

In the case of power interrupts exceeding 10 milliseconds, the ventilator will restart with a short self test lasting about 4 seconds – ventilation is then continued with the same values that were set before the power interruption.

If a lower alarm limit has been set for minute volume, the **MV low** alarm will be activated until the measured value for minute volume has risen above the lower alarm limit again.

With 12/24 V DC power supply option installed:

See Operating Instructions for the option Evita 4 DC (DC power pack).

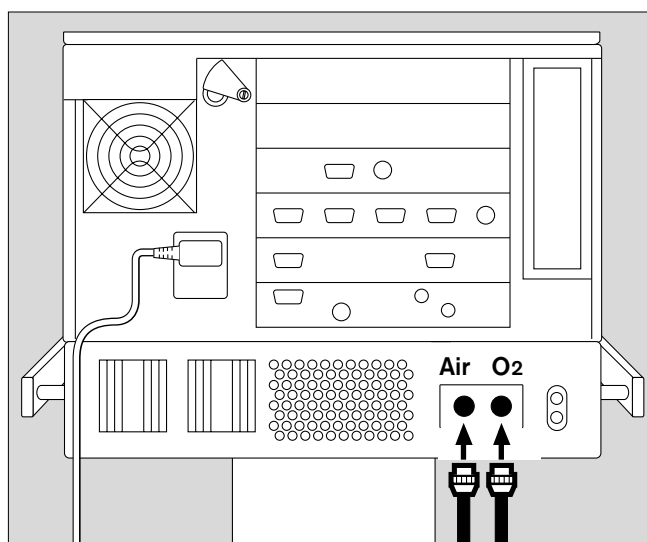
Gas Supply

WARNING !

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.

Supply pressures must be between 43.5 and 87 psi (3 to 6 bar)

- Screw high pressure Air and O₂ hoses to sockets on the back panel of Evita 2 dura and insert their probes into wall terminals.



Before Using for the First Time

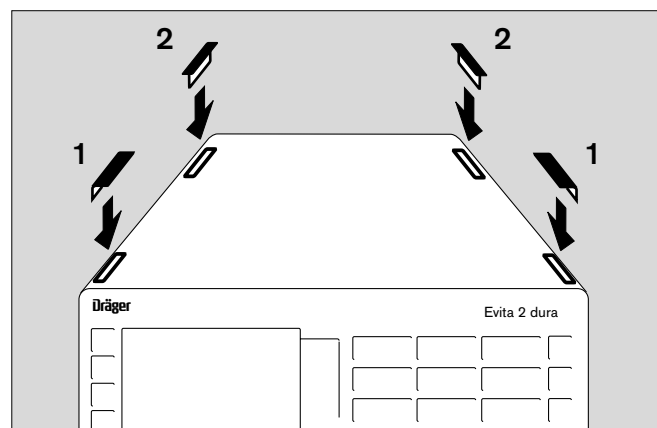
If no instrument tray (option) is placed on top of the ventilator:

Seal off the slots in the top panel with supplied rubber plugs:

- 1 Press rounded plugs in the front slots – rounded part facing outwards.
- 2 Press flat plugs into the rear slots.

CAUTION !

Do not place containers of liquids (such as infusion bags or bottles) on top of or over the Evita 2 dura ventilator. Liquids getting into the ventilator can cause equipment malfunction and damage.



Selecting a Screen Language

Evita 2 dura (US version) leaves the factory programmed with American English screen texts. Among others, e.g.

Spanish and **French** can be selected as your screen language. For instructions on selecting screen languages, please refer to »**Configuration**«, page 93.

NOTE: Please ask an authorized service technician if you would like to change the language on the control panel labels.



Evita Remote (Available Option)

Optional (wired) remote control pad

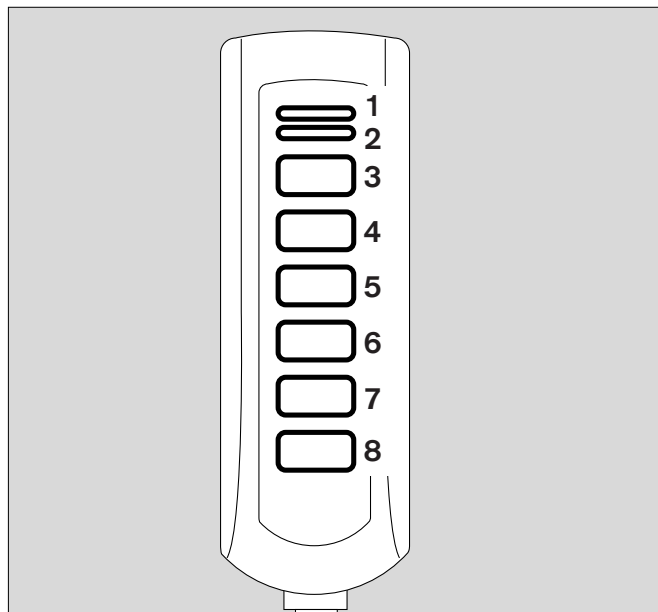
WARNING !

Installation and activation of the Evita Remote kit should only be performed by DraegerService or factory trained and authorized service personnel.


Used for the remote, redundant control of the following indicators and key functions:

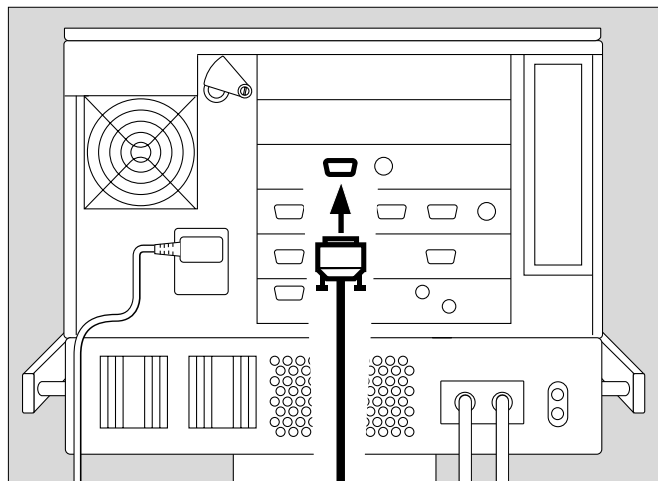
- 1 red indicator light – for signaling **WARNING** level alarm messages
- 2 yellow indicator light – for signaling **CAUTION** and **Advisory** level alarm messages
- 3 »  « key – for silencing the audible alarm for 2 minutes
- 4 » **Alarm Reset** « key – for acknowledging alarm messages
- 5 »  **Neb.** « key – for starting and stopping the nebulizing of medicated aerosols
- 6 » **O₂ ↑ Suction** « key – for pre-/post oxygenation when performing bronchial suction
- 7 » **Insp. hold** « key – for manual insufflation
- 8 » **Exp. hold** « key – for extending and holding an expiration

The function of the indicators and keys is equivalent to those of the respective control elements on the Evita 2 dura front panel and is described in the application chapters of this Operating Manual.

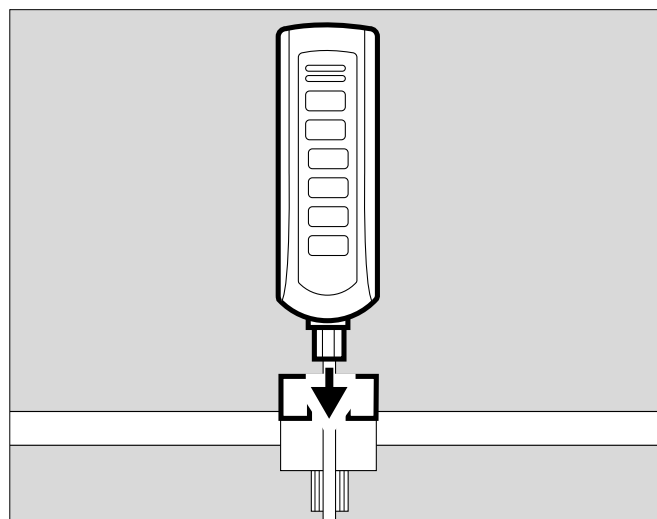


Connecting

- Insert connector of the remote control pad cable into the »  « receptacle on the back panel of Evita 2 dura. The connector may be plugged or unplugged at any time without affecting ventilator function.



- Attach remote pad support bracket to a wall rail and tighten.
- Insert remote pad into its holder from the top.



Observe automatic check at power-up

- when connecting the remote control pad to an operating ventilator,

or

- when switching ventilator on with the remote control pad connected.

- Do not press any keys on the remote control pad.
- All lights in the remote pad will light up for 5 seconds:
 - red indicator light
 - yellow indicator light
 - yellow indicators in the keys.
- Evita 2 dura now checks the remote control pad. In case of a fault, an advisory message will be displayed, see page 118, "Troubleshooting".

Nurse Call (Available Option)


Connection on the rear panel of Evita 2 dura intended for the transmission of alarm messages with highest priority (alarm level) to a central hospital alarm system.

WARNING !

Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized personnel.

- Have a qualified electrician perform the installation of the round 6-way DIN female connector to the line of the central alarm system.

Evita 2 dura activates the nurse call by closing contacts 3-5 whenever a level alarm is displayed.

- Connect plug to the receptacle marked »  « and secure with screws.
- Check connected nurse call system for proper operation.

WARNING !

The operator of the ventilator must still assume full responsibility for ventilation monitoring via the Evita 2 dura screen when the nurse call is connected.

Only alarms (highest priority alarms (!!!), see page 74) will activate the nurse call.

- Check screen displays frequently.

Alarms that are transmitted via nurse call are those indicated in red and with three exclamation marks in the top field of the Evita 2 dura screen. Caution and Advisory level messages are not transmitted. The nurse call is activated also when the original enunciator in the ventilator is faulty.

Background: the connected lines of the central alarm system only are a one-channel design. Therefore, the

WARNING !

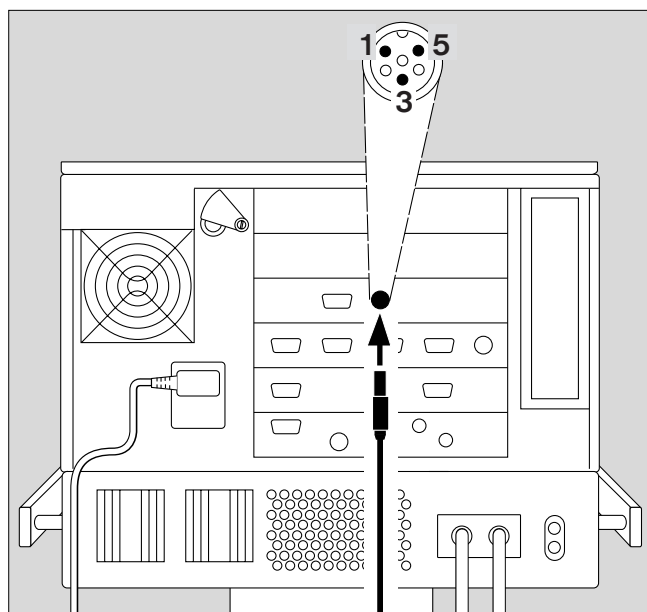
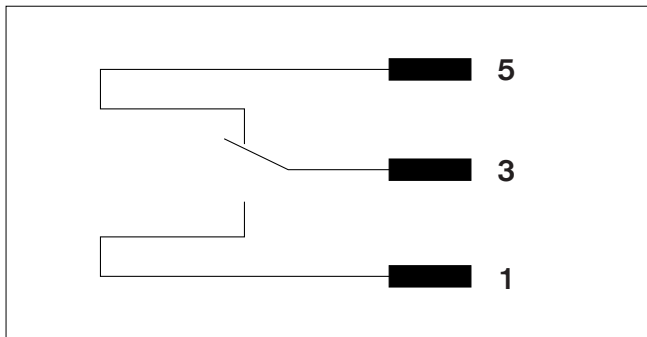
A fault within any component of the combination between the nurse call and the central alarm system of the hospital (e. g. inside the Evita 2 dura nurse call electronics, the Evita 2 dura power supply or the hospital alarm equipment) may result in a failure of a proper nurse call function.

internal electronics of the Evita 4 nurse call are a one-channel design as well.

Technical Data

Potential-free DC contact

Input voltage	max. 40 V DC
Input current	max. 500 mA
Switching power	max. 15 W



Checks of Readiness for Operation

Before using on a patient

- Immediately before using on the patient, check that the ventilator is working properly and is ready for operation.

WARNING !

The ventilator is ready for operation only when:

- it is completely assembled with all required auxiliary equipment in place,
- all sensors are calibrated (O₂, Flow)
- the »device check« has been completed successfully.

Evita 2 dura supports this »device check« with a built-in checklist that guides the user through the tests of readiness for operation in a dialog fashion.

The following tests are performed during the device check:

System:

- Expiratory valve
- Flow sensor
- Humidifier fill level
- Completeness of patient circuit

Functions:

- Air/O₂ crossover valve
- Safety relief valve
- Gas supply
- Auxiliary alarm (triggered if main alarm enunciator fails)
- Lamps, LEDs

Sensors:

- Flow sensor calibration
- O₂ sensor calibration

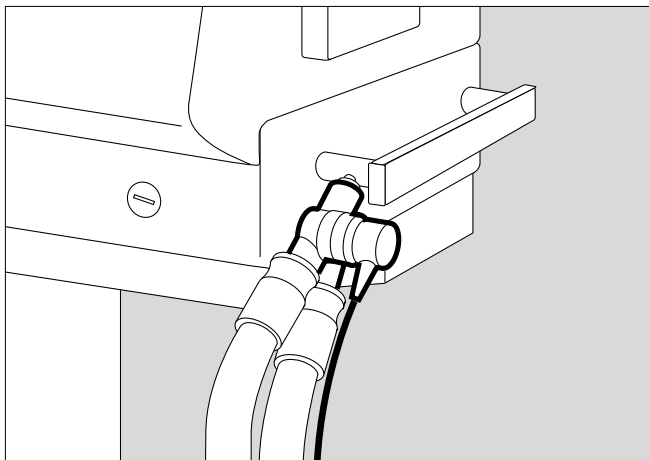
Tightness of patient system:

- Leakage
- Compliance
- Resistance

NOTE: The test results obtained from this device check and the calibration values of the sensors remain stored until the next calibration – even if the ventilator is switched off.

Preparing for the Check Procedure

- Connect Y-piece to its park bracket on the right side of the ventilator.



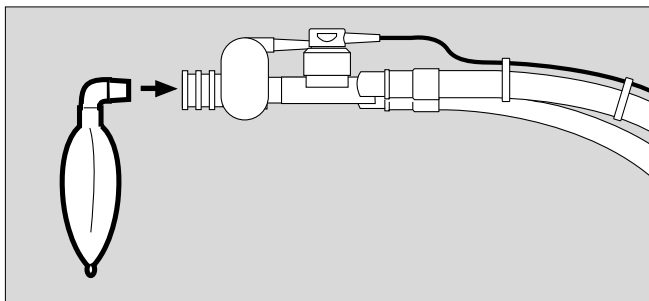
Preparing the adult test lung 84 03 201

for the adult patient circuit

The test lung assembly consists of an elbow connector for connection to the Y-piece, a 7 mm diameter ET-tube connector for simulating airway resistance and a 2 liter breathing bag to simulate compliance.

NOTE: Do not use permanently stretched breathing bags, these might cause artifacts during the check procedures.

- Insert the elbow connector into the Y-piece only when Evita 2 dura advises you on screen to do so.

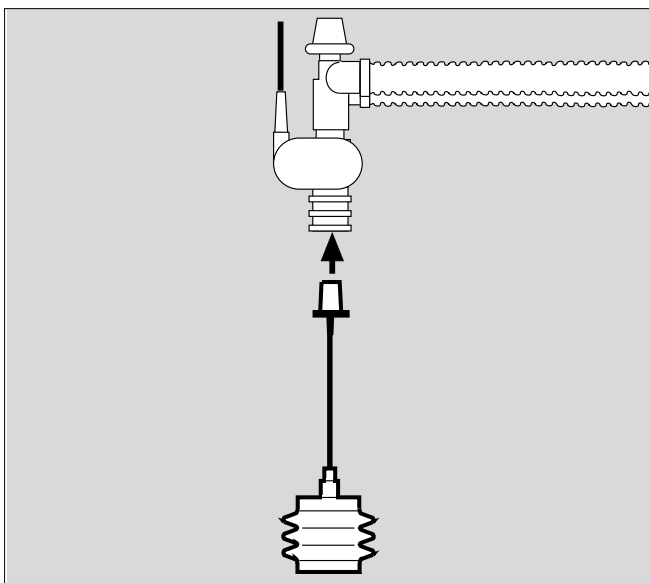


Preparing the infant test lung 84 09 742

for use with the infant patient circuit

The test lung consists of a tracheal tube CH 12 to simulate airway resistance and a small bellow to simulate compliance.

- Insert the elbow connector into the Y-piece only when Evita 2 dura advises you on screen to do so.

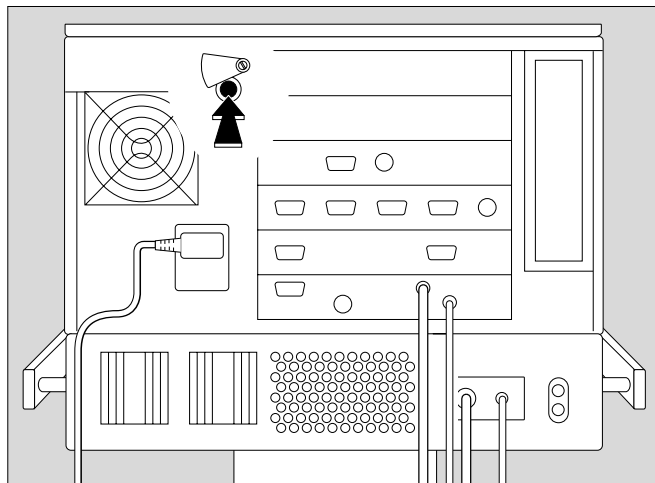


Starting Ventilator Check

- To switch ventilator on, press power switch on the back panel until it clicks into position.


Evita 2 dura now runs a self test.

- Wait until the 10-second test has been completed.

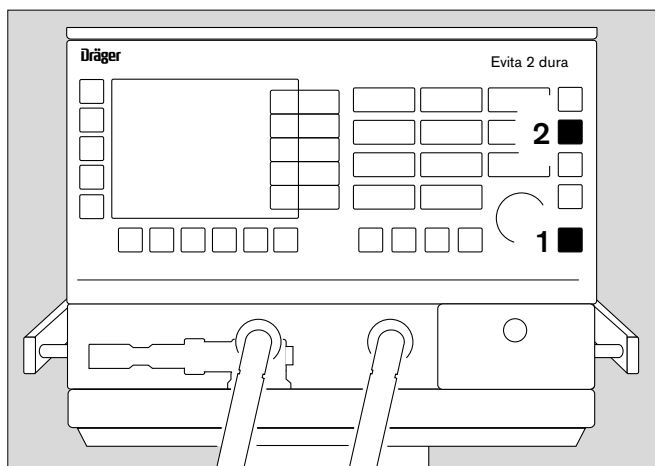


After the self-test:

- 1 Hold down »**Standby**« key for about 3 seconds to switch Evita 2 dura to standby.
- 2 Switch off standby audible alarm with »**Alarm Reset**« key.

NOTE: The audible alarm associated with standby cannot be silenced with »« key

- Press »**Check**« menu key.



Enter the chosen type of humidifier before starting the check procedures:

- Heated (active) humidifier
or
- HME/filter (passive, artificial nose)

Knowing the type of humidifier used, the ventilator is able to take into account the respective conditions regarding humidity and temperature when performing volume measurements.

- Touch »**Humid.**« screen key.

Display:

- Touch screen key »**Active Humid.**«
or
- touch screen key »**HME/Filter**«.
- Press dial knob to confirm selection.

The ventilator marks the selected type of humidifier with a yellow LED in the screen key.

The humidifier type selection remains stored and will be in effect upon restarting the ventilator.

In case of a change in the type of humidification requiring a renewed on-screen selection after the ventilator check, the ventilator marks the following test steps as invalid (– –).

- humidification
- leak test.

This suggests to repeat the device check for these two tests.

Display:

Start the check procedure:

- Activate the »**Start**« screen key = press dial knob

Evita 2 dura starts running through the dialog-oriented tests.

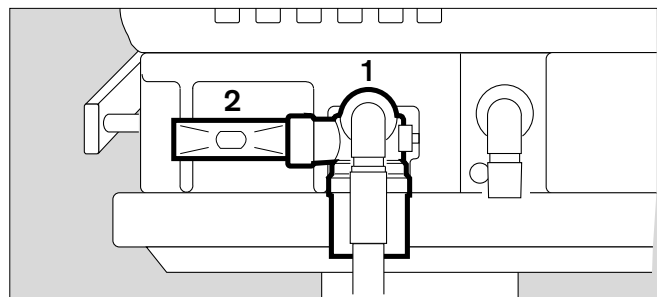
The test procedure is semi-automatic.

During the ventilator check, the user is instructed by Evita 2 dura to perform specific actions on the ventilator.

Ventilator

Expiratory valve

- 1 Correctly inserted and seated?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.

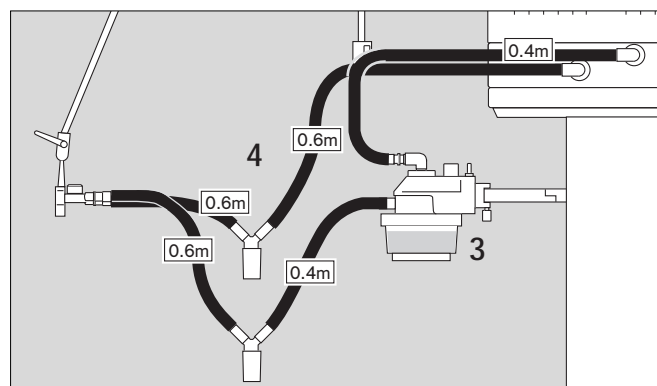


Flow sensor

- 2 Correctly seated?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.

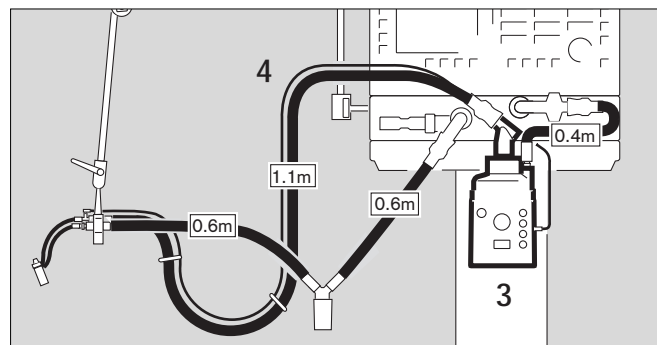
Humidifier level

- 3 Filled with enough water?
Humidifier ready for operation?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.



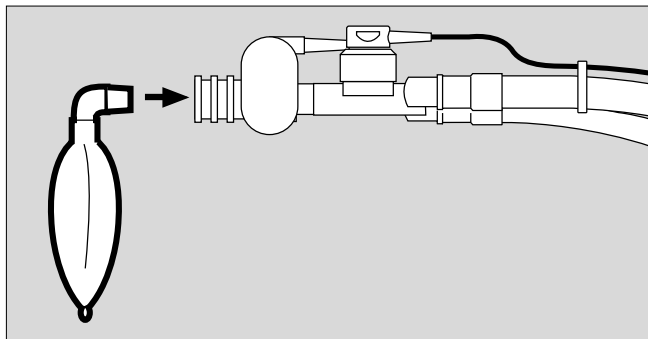
Patient circuit

- 4 Patient circuit system correctly assembled?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.



Air-O₂ crossover valve

- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.
- Connect adult test lung to Y-piece.
- Press dial knob to confirm with »Yes« screen key.
- Remove O₂ connector from wall supply terminal.
The ventilator now checks the function of the Air/O₂ crossover valve.



Safety valve

- Reconnect O₂ connector.
Disconnect the Air connector at the supply terminal.
- The ventilator detects the failure of the medical air supply.
- Reconnect Air connector.

Gas supply

- The ventilator checks that the connectors for medical air and O₂ are connected.

Auxiliary alarm

- Does audible **alarm** sound?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.

Lamps/LEDs

- Do all lamps/LEDs light up?
- Turn dial knob to select »Yes« screen key.
Press dial knob to confirm.

Flow sensor calibration

- Press dial knob to confirm with »Yes« screen key.

O₂ sensor calibration

- Press dial knob to confirm with »Yes« screen key.

Patient Circuit Performance

- Press the »Check ►►« key to select the »Tightness« menu.
- Press dial knob to activate »Start« screen key.
- See advisory messages in lower display area.

Leakage

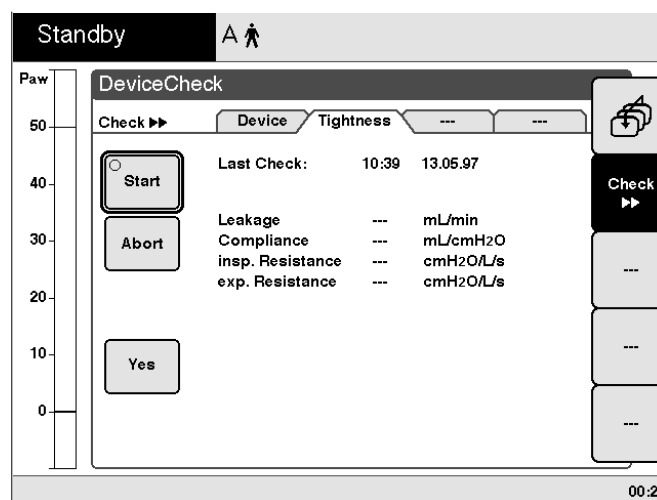
- The device determines leakage in L/min with reference to a pressure of 60 cmH₂O.

NOTE: The leakage test can also be selected independently.

In Standby mode:

- Press »Check ►►« menu key.
- Select »Tightness« menu with »Check ►►« menu key.

NOTE: Corrective measures to eliminate leaks can take advantage of the continuous display of leakage values.



Compliance

- The ventilator calculates system compliance in mL/cmH₂O.

This calculated system compliance is used for automatic correction of volume-controlled ventilator breaths and of measured values from flow monitoring.

After changing the patient circuit:

- Repeat leak test.

Resistance

- The ventilator calculates inspiratory and expiratory resistance in cmH₂O/L/s.

Upon completion of the ventilator check, a checklist is displayed on screen showing the test results.

Correct result : ✓
 Incorrect result : F
 Check not performed : --

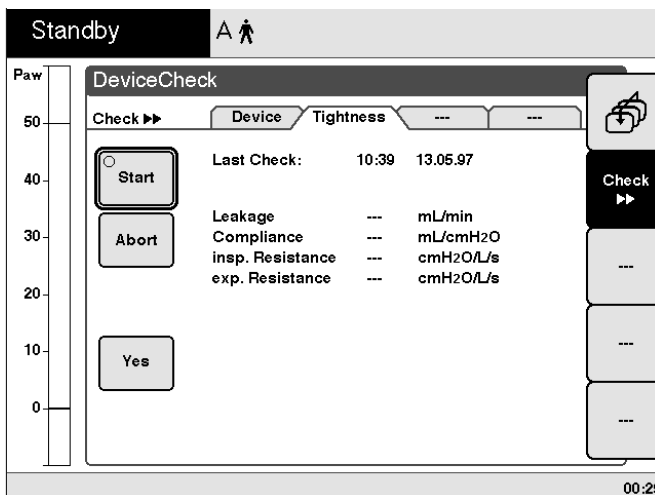
In the event of incorrect results, e.g. if a patient circuit is leaking:

- Eliminate the cause of the problem.
- Turn dial knob to select »Repeat« screen key.
 Press dial knob to activate.

NOTE: Only the tests with incorrect results are repeated.

NOTE: For immediate operation (e.g. in an emergency) the ventilator check procedure can be interrupted:

- Press »Standby« key.
 The ventilator starts ventilation immediately.



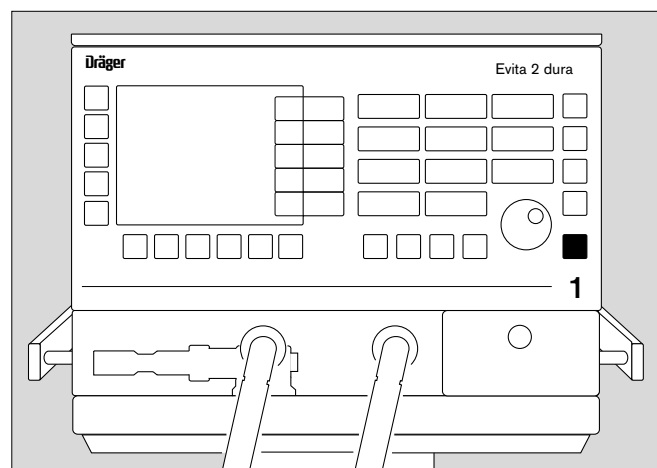
After successful completion of the device check,
Evita 2 dura is now ready for operation.

Either:

- leave Evita in standby mode and preset ventilation mode and ventilation parameters as needed,

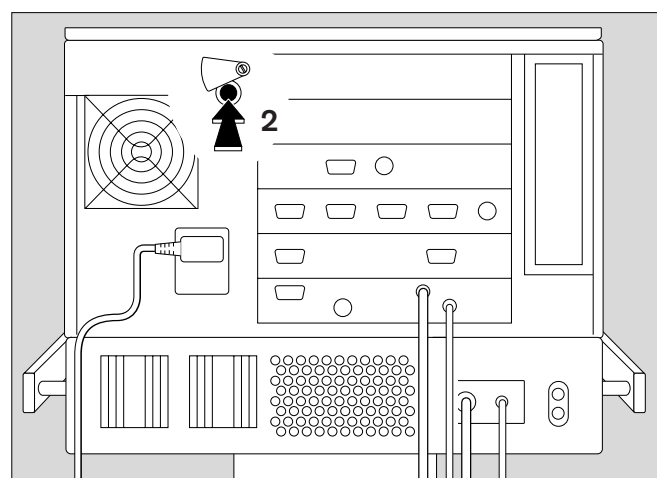
or:

- 1 immediately start up Evita 2 dura by pressing
»Standby« key,



or:

- 2 switch off Evita for later use.
Pivot switch cover on the back panel to the side,
then press button in fully and release.



Testing patient circuit for leaks

The patient circuit is tested for leaks as part of the standard ventilator check procedure, but it should also be tested independently, e.g. after exchanging the patient circuit.

- Select »**Tightness**« menu with »**Check ►►**« menu key.
- Press dial knob to activate »**Start**« screen key.

During the test, Evita 2 dura continuously displays leakage flow.

A leakage flow up to 300 mL/min at a pressure of 60 cmH₂O is acceptable.

After the leak test, Evita 2 dura determines compliance and resistance of the patient circuit.

Evita 2 dura uses the calculated compliance value to automatically correct volume controlled ventilator breaths, as well as values measured as part of flow monitoring, see page 151.

Evita 2 dura uses calculated patient circuit resistance for correcting pressure values measured in the presence of a base flow (NeoFlow option).

NOTE: When changing patient mode or type of humidifier, the ventilator automatically resets values for patient circuit compliance and resistance to their defaults.

Performing the patient circuit leak test, the ventilator will determine the current values for compliance and resistance. Therefore:

When exchanging patient circuit or changing patient mode.

- Always perform leak test.

Operation

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Precautions During Operation

WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O₂ concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.

WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O₂ concentrations < 24 %.
- Always secure O₂ cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O₂ equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

WARNING !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO₂ according to the blood gas values measured.

WARNING !

Do not block air intake. Ventilator malfunction will result.

CAUTION !

Do not place containers of liquids (such as infusion bags or bottles) on top of or over the Evita 2 dura ventilator. Liquids getting into the ventilator can cause equipment malfunction and damage.

Routine checks during operation

- About every hour, check inspiratory gas temperature.
- About every 2 hours, empty water traps in patient circuit.
- Periodically inspect O₂ and Air inlet water traps. Drain water from bowls when necessary.

Starting Up

Switching On

- Push in power switch on back panel until it clicks into place = ON.
The protective cover will swivel over the switch button to prevent the ventilator from being inadvertently switched off.

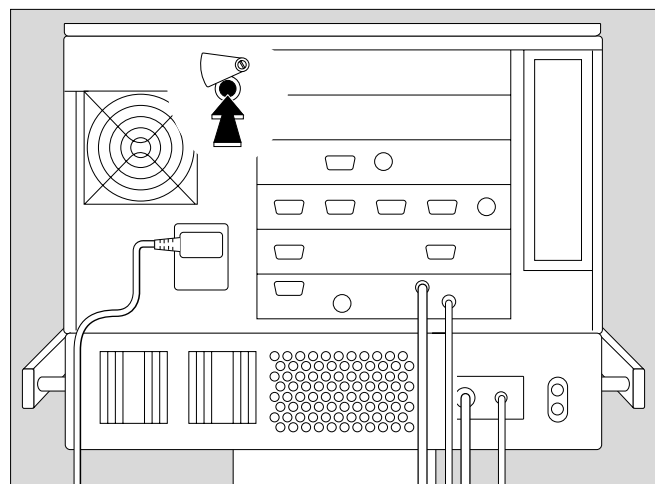
Evita 2 dura now performs the power-up self-test.

- Wait until the 10-second test is completed.

The ventilator starts ventilation with the preselected default values.

To select different start-up values, see page 98.

After power outages or periods of standby, the settings in effect immediately before the interruption of ventilation will be used again.



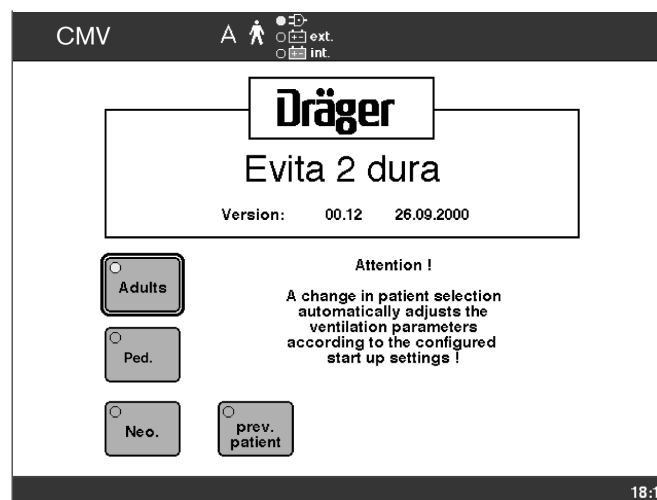
Patient Mode

For factory delivered ventilators, Evita 2 dura offers the following patient modes after power-up.

- »Adults« = adult patient
- »Peds.« = pediatric patient
- »Neo.« = neonatal patient
(when using NeoFlow option)
- »prev. patient« = previous patient

Example:

Ventilation of an adult patient



With this information, Evita 2 dura determines the ranges of adjustment and the startup values of the ventilation parameters.

The startup defaults with respect to the selected patient mode may be configured by the user, see "Configuration" on page 91.

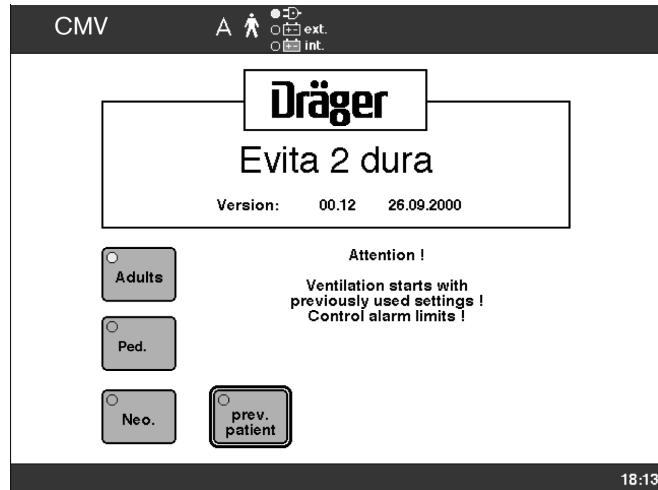
The »**prev. patient**« screen key offers the option to restore all patient related settings including alarm limits and monitoring status from the time before the ventilator was last switched off.

Example:

Previous patient

In the status field, the previous mode settings appear:

- previous ventilation mode (example: PCV+)
- previous patient mode (example: A = adult)
- previous application mode - tube or mask if NIV option is installed (example: no NIV installed)



In case of data loss or removal of a previously available option (e.g. NeoFlow), Evita 2 dura will prevent restoration of previous setting by not showing the »**Prev. patient**« key. Evita 2 dura will also not allow previous settings if the ventilator was configured in such a way that the previous patient mode is not available any more.

Selecting the Patient Mode

Either

- Select one of the screen keys:
 - »**Adults**«, or
 - »**Ped.**«, or
 - »**Neo.**«, (with option NeoFlow installed)
 by turning the dial knob, and
- press dial knob to confirm.

Or:

Select previous settings:

- Turn dial knob to select »**prev. patient**«, and
- press dial knob to confirm.

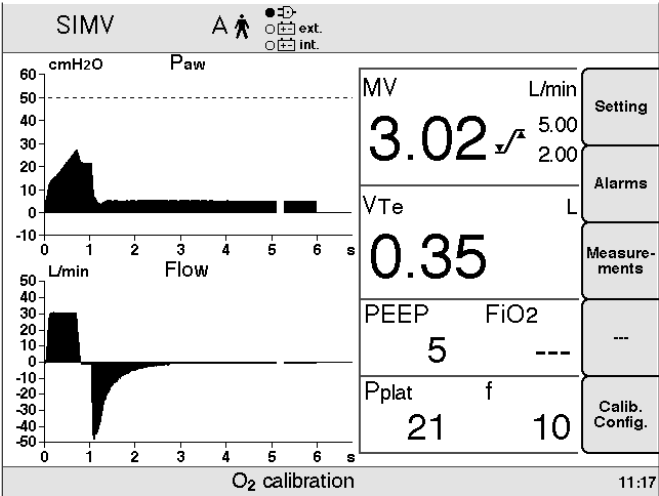
Starting Ventilation

Evita 2 dura starts ventilation with the ventilation mode and patient-specific settings configured by the user or with the settings last used before the ventilator was switched off. See page 98 for instructions on changing start-up default settings.

If no new selection was made or the dial knob was not pressed, the ventilator will automatically start ventilation after 30 seconds in the patient mode last used and with the previously selected ventilation mode and respective ventilation parameters.

The Evita 2 dura screen then displays the main screen page.

The user may check and correct the settings in the display fields next to the parameter keys.



Setting Ventilation Modes

To set ventilation parameters:

- 1 Press appropriate parameter key.
The yellow LED in the key will light up.
- 2 Turn dial knob to set desired value.
Press dial knob to confirm value.
The yellow LED will go out.

If the setting is at the upper or lower limit of the adjustment range for a parameter, the LED in the relevant key will start flashing.

- 2 Press dial knob to acknowledge.

NOTE: If new settings are not confirmed/acknowledged within 30 seconds, the previous settings will remain in effect.

Pre-setting parameters for a ventilation mode not currently active

- 1 Press and release the respective parameter key. Its LED will start flashing.

The keys for parameters relevant to the new ventilation mode will start flashing in the block of parameter keys.

Set new ventilation parameters:


- 1 Press the respective key: its LED will stop flashing and remain constantly lit.
- 2 Turn dial knob to set desired value.
Press dial knob to confirm value. The LED will go out.

To activate the ventilation mode:


- 3 Use keys for ventilation modes:
 - **CMV**
 - **SIMV**
 - **PCV+**
 or
- 4 »Other Modes« key for other ventilation modes that are set on-screen. Factory-set default: CPAP/PSupp.
 - Hold down the respective key for 3 seconds, or
 - Briefly press and release the respective key and press dial knob.

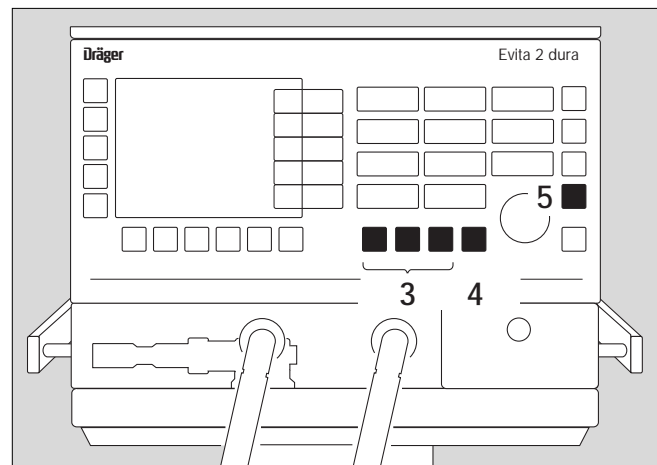
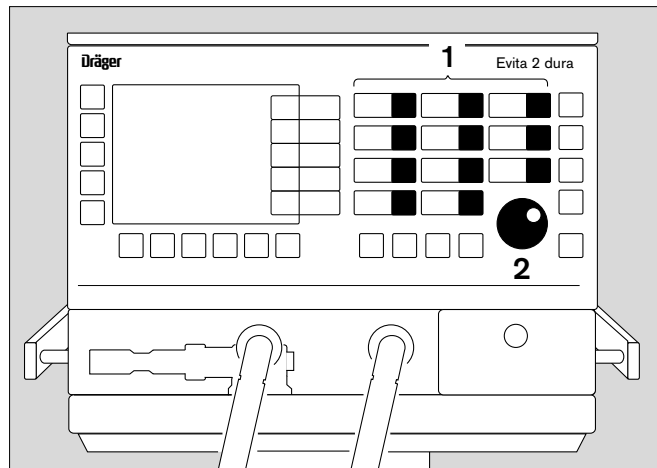
The selected ventilation mode will now be active.

To protect settings against unauthorized changes

- 5 Press »« key. Its yellow LED will light up. The parameter keys and ventilation mode keys will be protected against inadvertent setting.

Before setting a new value:

- 5 Press »« key. The yellow LED will go out.



CMV

Continuous Mandatory Ventilation

Volume controlled ventilation with fixed, mandatory minute volume MV and user-adjustable tidal volume V_T and rate f .

Used for patients without spontaneous breathing.

- Set a ventilation pattern for CMV with parameters:

Tidal volume » **V_T** «

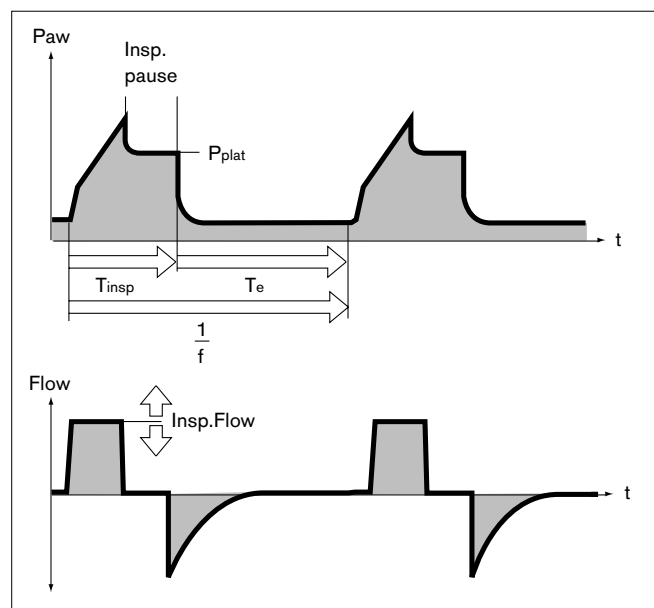
Insp. Flow »**Flow**«

Breath rate » **f** «

Inspiratory time » **T_{insp}** «

O₂ concentration »**O₂**«

Positive end-expiratory pressure »**PEEP**«



CMV can be extended with the following ventilation parameters:

Trigger (CMV Assist) – for synchronization with a patient's spontaneous breathing. Switching the trigger on and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

The trigger can be switched off when synchronization with the patient's inspiratory efforts is not desired.

To activate/set:

- Press »**Trigger**« parameter key.
- Turn dial knob to set value.
Press dial knob to confirm value.

To deactivate:

- Set a value less than 0.3 or above 15 L/min.
The display will then show: – – –

Intermittent PEEP (Sigh) – for prophylactic treatment of atelectasis.

Switching on and setting an intermittent PEEP will increase end-expiratory pressure increases for two ventilator breaths every 3 minutes by the value set for intermittent PEEP.

P_{max}

CMV can be configured with the additional ventilation parameter P_{max} for pressure limited ventilation.

- Activate »P_{max} pressure limiting«, see page 100.
- Set value of P_{max} with »P_{insp}« parameter key.

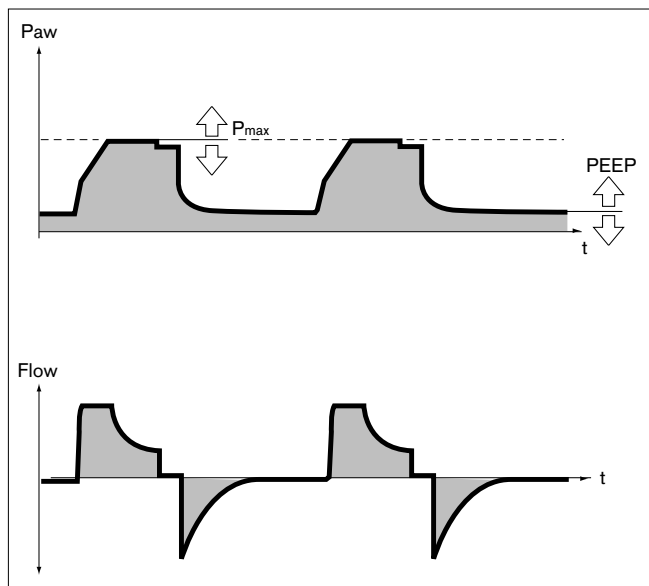
Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the P_{max} pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

Volume monitoring is always active.

The "Volume not constant" alarm is triggered automatically if the tidal volume V_T can no longer be delivered.

The value set for P_{max} is used (limited to a maximum of 50 cmH₂O) when switching from CMV to a pressure controlled mode of ventilation (blinking display for »P_{insp}«).

- Press dial knob to confirm
or
set a different value.



* For a detailed description of PLV, see page 144.

Synchronized Intermittent Mandatory Ventilation* Pressure Support**

Set a ventilation pattern for SIMV and SIMV/PSupp.
with parameters:

Insp. flow »**Flow**«Breath rate »**f**«

NOTE: Setting of $f = 0$ bpm switches ventilator to CPAP mode.

Inspiratory time »**T_{insp}**«

Trigger sensitivity »Trigger«

O₂-concentration »O₂«

Positive end-expiratory pressure »**PEEP**«

In addition, for SIMV/PSupp.:

Support pressure »**P_{Supp.}**«

Pressure rise time »**Slope**«

SIMV and SIMV/PSupp. can be extended with the following ventilation parameters:

Apnea Ventilation – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

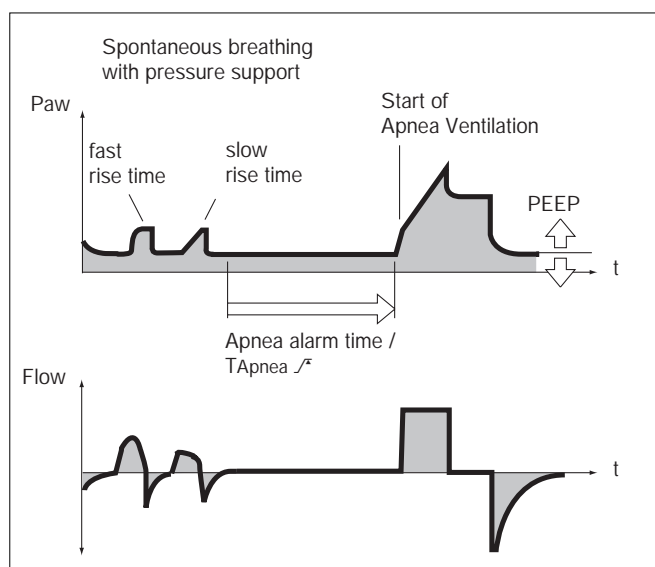
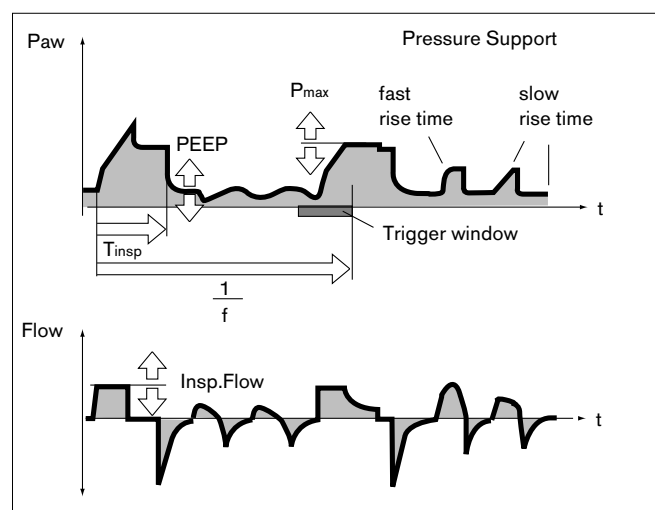
If breathing stops, Evita 2 dura will trigger an alarm after the set alarm time (T_{apnea}) and will start volume controlled ventilation with the preset ventilation parameters:

Breath rate »fApnea«

Tidal volume »**V_TApnea**«

NOTE: Patients can breathe spontaneously during apnea ventilation. Apnea ventilation rate will remain constant.

For setting apnea ventilation, see page 71.



* Refer to page 146 for a detailed description of SIMV.

** Refer to page 147 for a detailed description of Pressure Support.

P_{max}

SIMV can be configured with the additional ventilation parameter P_{max} for pressure limited ventilation.

- Activate »P_{max} pressure limiting«, see page 100.
- Set value of P_{max} with »P_{insp}« parameter key.

Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the P_{max} pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

Volume monitoring is continuously active. If the tidal volume V_T can no longer be delivered, a "Volume not constant" alarm is automatically generated.

PCV+, PCV+/PSupp.**Pressure Controlled Ventilation Plus**

Pressure-controlled ventilation combined with free spontaneous breathing at any time during the breathing cycle and adjustable pressure support at CPAP level. The mandatory portion of the total minute volume MV is set with inspiratory pressure P_{insp} and breath rate f.

May be adapted to a wide range of patients, from those unable to breathe spontaneously at all to those breathing spontaneously just before extubation. Patients are weaned off the ventilator by incrementally reducing the mandatory portion of the overall minute volume MV and/or reducing support pressure P_{Supp.}.

In the course of the weaning process, the ventilator rate may be reduced down to 0. The ventilator will then automatically switch to CPAP or CPAP/P.Supp. ventilation mode and it will also indicate this new ventilation mode.

Set the ventilation pattern for PCV+ with the ventilation parameters:

Inspiration pressure »P_{insp}«, set as an absolute value.

Breath rate »f«

NOTE: When f = 0/min, the ventilator switches to CPAP mode.

Inspiratory time »T_{insp}«

Trigger sensitivity »Trigger«

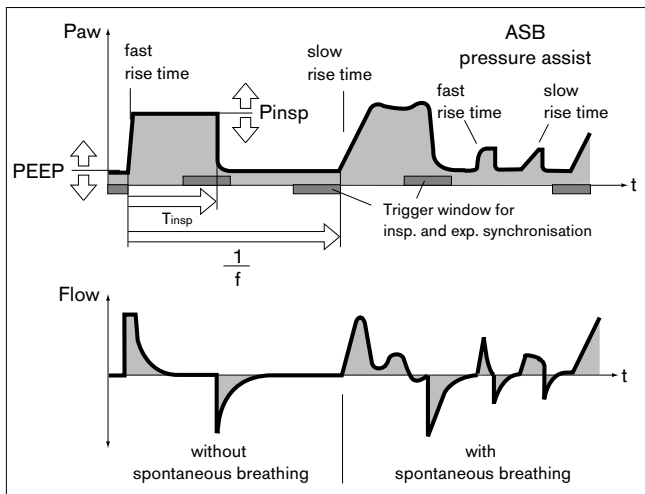
O₂ concentration »O₂«

Positive end-expiratory pressure »PEEP«

In addition, for PCV+/ P_{Supp.}:

Pressure support »P_{Supp.}«, set relative to the PEEP level.

Pressure rise time »Slope«



* For a detailed description of PLV, see page 144.

PCV+ can be supplemented with the following ventilation parameters:

Apnea ventilation – for automatic switching to volume controlled mandatory ventilation if the patient stops breathing.

If spontaneous breathing stops, Evita 2 dura will trigger an alarm after the set alarm time ($T_{\text{apnea}} \searrow$) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate » f_{apnea} «

Tidal volume » $V_{\text{T apnea}}$ «.

NOTE: Patients can breathe spontaneously during apnea ventilation. Apnea ventilation rate will remain constant.

For setting apnea ventilation, see page 71.

PCV+Assist (BIPAPAssist)

Pressure Controlled Ventilation Plus, Assisted

Pressure controlled, assisted ventilation

Delivered breaths are equivalent to those of PCV+ However, the switch from P_{insp} to PEEP pressure is not synchronized with patient expiration. Spontaneous breathing may occur at anytime at the upper pressure level.

Each detected spontaneous inspiratory patient effort at PEEP pressure level will trigger a synchronized ventilator breath.

The ventilator will deliver an (unsynchronized) breath at the latest after the time defined by » f « has elapsed.

Used for patients without spontaneous breathing all the way to spontaneously breathing patients just before extubation.

Set the ventilation pattern for PCV+Assist (BIPAPAssist) with the ventilation parameters:

Inspiratory pressure » P_{insp} «

Breath rate » f «

Inspiratory time » T_{insp} «

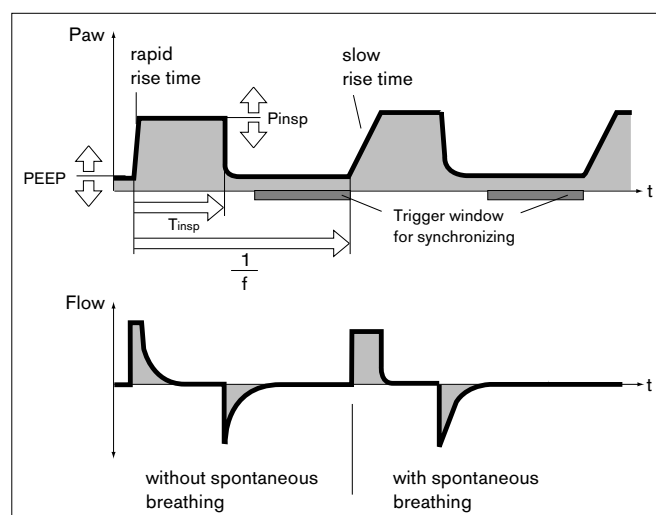
O₂ concentration » O_2 «

Positive end-expiratory pressure » $PEEP$ «

Pressure rise time » \nearrow «

Trigger sensitivity » Trigger «

Inspiratory pressure » P_{insp} «, set in absolute terms.



To activate:

- Press menu key »**Other Modes**«.

If PCV⁺Assist has been selected with the cursor:

- Keep menu key »**Other Modes**« menu key pressed for approximately 3 seconds,
or
- press dial knob.

Else:

- Select PCV⁺Assist by turning dial knob.
Press dial knob to activate.

The "LED" in »**PCV⁺Assist**« screen key changes color from green to yellow. PCV⁺Assist ventilation mode is now active and is displayed in the status field.

CPAP, CPAP/PSupp.

Continuous Positive Airway Pressure
Pressure Support

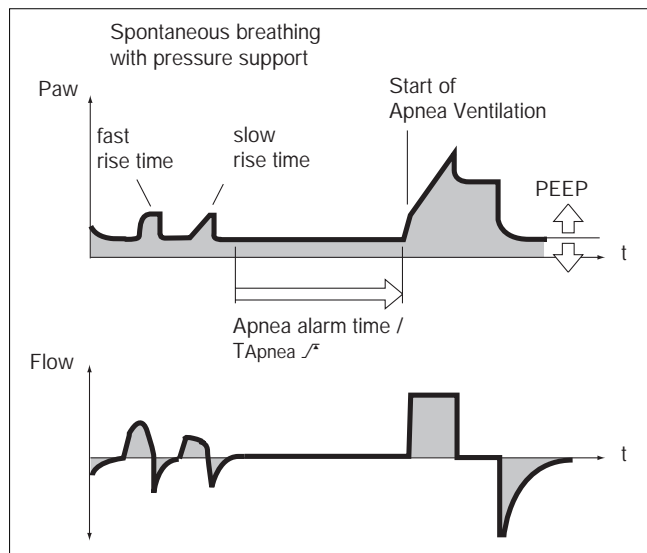
Spontaneous breathing at a raised pressure level in order to increase the functional residual capacity (FRC). Spontaneous breathing can be augmented with additional pressure via pressure support.

Used for patients breathing spontaneously.

- Set ventilation pattern for CPAP and CPAP/PSupp. with the following ventilation parameters:
O₂ concentration »**O₂**«
Positive end-expiratory pressure »**PEEP**«

In addition, for CPAP/PSupp.:

Support pressure »**PSupp.**«
Pressure rise time »**Slope**«
Sensitivity »**Trigger**«



To activate:

- Press menu key »**Other Modes**«.

If CPAP/PSupp. has been selected with the cursor:

- Keep menu key »**Other Modes**« menu key pressed for approximately 3 seconds,

or

- press dial knob.

To Select:

- Select CPAP/PSupp. by turning dial knob.
Press dial knob to activate.

The "LED" in »**CPAP/PSupp.** « screen key changes color from green to yellow. CPAP/PSupp. ventilation mode is now active and is displayed in the status field.

NOTE: You may also activate CPAP/PSupp. by setting a breath rate of $f = 0$ in either SIMV or PCV+.

CPAP and CPAP/PSupp. can be extended with the following ventilation parameters:

Trigger – for synchronization with a patient's spontaneous breathing efforts.

Switching trigger on and setting a trigger sensitivity will synchronize supported and mandatory breaths with the patient's spontaneous inspiratory efforts

Apnea Ventilation – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

If breathing stops, Evita 2 dura will trigger an alarm after the set alarm time (T_{apnea}) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate »**f apnea**«

Tidal volume »**VT apnea**«

NOTE: Patients can breathe spontaneously during apnea ventilation. Apnea ventilation rate will remain constant.

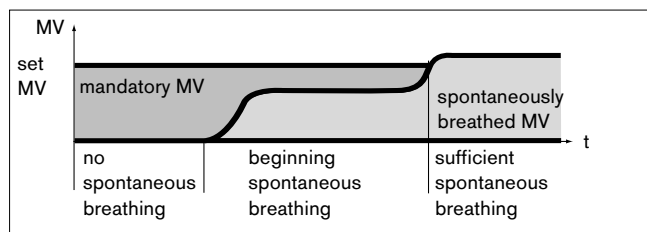
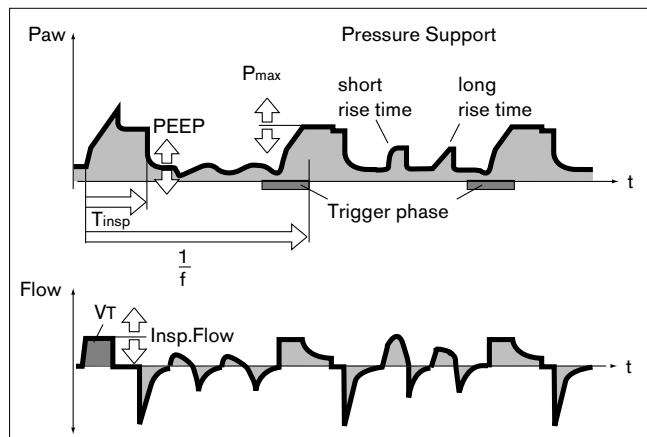
For setting apnea ventilation, see page 71.

MMV*, MMV/PSupp.**Mandatory Minute Volume Ventilation
Pressure Support**

The overall minute volume is preset to a mandatory level, which can be adjusted via tidal volume V_T and breath rate f .

The patient can breathe spontaneously, thereby contributing a portion of the overall minute volume. The difference between the spontaneously breathed minute volume and the set minute volume is provided by mandatory ventilator breaths. Spontaneous breathing can be augmented with pressure support.

This mode is intended for patients being weaned off the ventilator by incrementally reducing the mandatory portion of overall minute volume.



- Set the ventilation pattern for MMV and MMV/PSupp. with the ventilation parameters:

Tidal volume »**VT**«

Insp. flow »**Flow**«

Breath rate »**f**«

Inspiratory time »**T_{insp}**«

Sensitivity »**Trigger**«

O₂ concentration »**O₂**«

Positive end-expiratory pressure »**PEEP**«

In addition, for MMV/PSupp.:

Support pressure »**PSupp.**«

Pressure rise time »**Slope**«

To activate:

- Press menu key »**Other Modes**«.

If MMV has been selected with the cursor:

- Keep menu key »**Other Modes**« menu key pressed for approximately 3 seconds,
or

- press dial knob.

To Select:

- Select MMV by turning dial knob.
Press dial knob to activate.

The "LED" in »**MMV**« screen key changes color from green to yellow. MMV ventilation mode is now active and is displayed in the status field.

* For a detailed description of MMV, see page 150.

P_{max}

CMV can be configured with the additional ventilation parameter P_{max} for pressure limited ventilation.

- Activate »P_{max} pressure limiting«, see page 100.

Pressure Limited Ventilation (PLV)* – for manually limiting pressure peaks using the P_{max} pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration. Volume monitoring is continuously active. If the tidal volume V_T can no longer be delivered, a "Volume not constant" alarm is automatically generated.

Apnea Ventilation

Provides automatic switch to volume controlled, mandatory ventilation if the patient stops breathing. Apnea ventilation can be switched on in the ventilation modes SIMV, PCV+ (BIPAP), CPAP, APRV. Evita 2 dura generates an apnea alarm if, during the set apnea time »T_{Apnea}«, no expiratory flow was measured and/or no sufficient inspiratory gas delivery was performed.

In the event of an apnea, Evita 2 dura will trigger an alarm after the set alarm delay time (T_{Apnea} $\sqrt{\text{r}}$) and will start volume controlled ventilation with the set ventilation parameters:

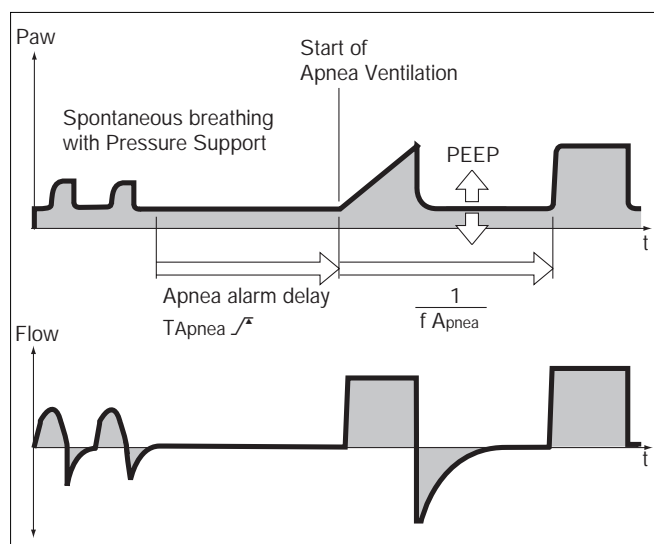
Breath rate »f_{Apnea}«

Tidal volume: »V_{TApnea}«

Ventilation parameters »O₂« and »PEEP« will correspond to the settings effective at the time.

Inspiratory time for apnea ventilation is determined from the set breath rate »f_{Apnea}« and a fixed I:E ratio of 1:2.

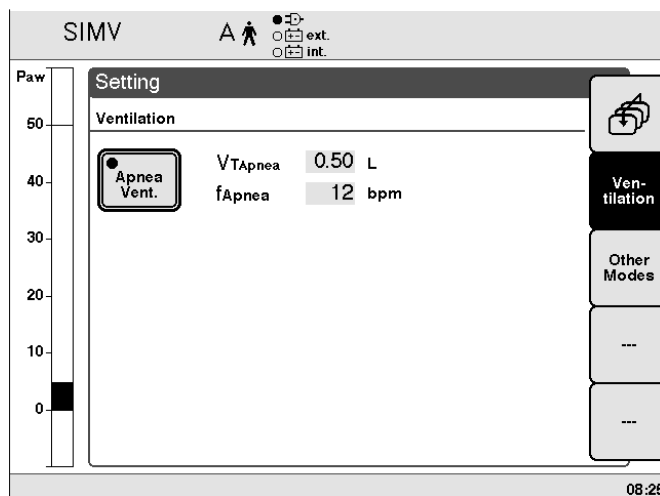
Just as in SIMV, the patient is allowed to breathe spontaneously during apnea ventilation, and mandatory breaths are synchronized with the patient's spontaneous breathing. The breath rate during apnea ventilation remains constant under these circumstances.



* For a detailed description of PLV, see page 144.

To set apnea ventilation:

- Press »**Settings**« menu key.
- Turn dial knob to select »**Apnea vent.**« screen key. Press dial knob to activate backup apnea ventilation. The "LED" in »**CPAP/PSupp.**« screen key changes color from green to yellow. PCV+Assist ventilation mode is now active.
- Turn dial knob to select »**VTApnea**«. Press dial knob to activate.
- Turn dial knob to set value. Press dial knob to confirm.
- Select, set and confirm rate »**fApnea**« correspondingly.



To end apnea ventilation:

- Press the »**Alarm Reset**« key: the ventilator will continue ventilating in the original ventilation mode.
- Or,
- select a different ventilation mode.

Please refer to page 101 for configuring the default status of apnea ventilation at start-up.

Setting Alarm Limits

- Press »Alarms« key.

Display screen »Limits« (example):

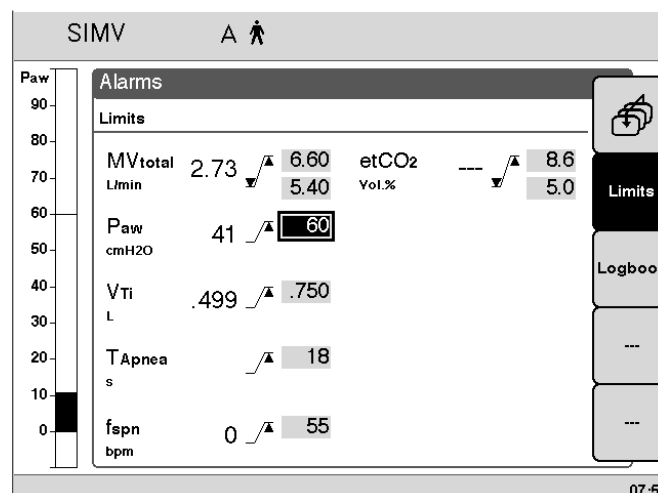
This page displays all the adjustable alarm limits.

↙ = lower alarm limit

↗ = upper alarm limit

Example: Setting upper alarm limit for f_{spont}.

- Turn dial knob to select screen field f_{spont} with cursor.
press dial knob to confirm.
- Turn dial knob to adjust value,
press dial knob to confirm.



No lower alarm limit has to be set for airway pressure P_{aw}, which is automatically linked to the PEEP setting.

No alarm limits have to be set for O₂ concentration. These limits are automatically linked to the setting of O₂ concentration.

Lower alarm limit:

Setting – 4 Vol.% (for settings up to 60 Vol.%)

Setting – 6 Vol.% (for settings from 60 to 100 Vol.%)

Upper alarm limit:

Setting + 4 Vol.% (for settings up to 60 Vol.%)

Setting + 6 Vol.% (for settings from 60 to 100 Vol.%)

Parameter Adjustment Ranges

Ventilation Parameter	Adjustment Range	Factory setting	Hospital-specific setting*
MV _{total} ↙↗ L/min	0.5 to 41 0.1 to 40	MV _{total} +50 % MV _{total} –20 %	.... ....
P _{aw} ↙↗ cmH ₂ O	10 to 100 no lower alarm limit	50	....
V _{Ti} ↙↗ L	0.03 to 4 no lower alarm limit	V _{Ti} + 100 %	....
T _{Apnea} ↙↗ s	15 to 60 no lower alarm limit	15	....
f _{spont} ↙↗ bpm	0 to 120 no lower alarm limit	50	....

* Hospital selected values may be entered into the last column for reference

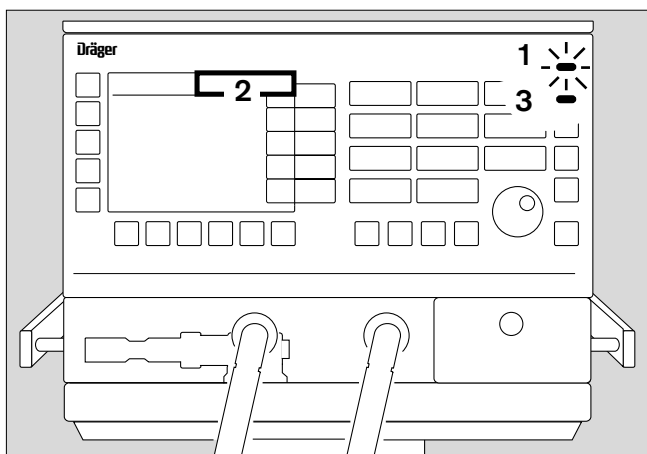
In the Event of an Alarm

- 1 The red or yellow light will flash.
- 2 An alarm message will be displayed in the top right-hand corner of the screen.

Evita 2 dura determines the priority of the alarm message, marks the text with exclamation marks, and generates the different audible alarm sequences.

WARNING !

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.



Alarm Categories

Warning = top priority message

- 1 The red light flashes.
Warning messages are marked with three (3) exclamation marks.
Example: **!!! Apnea**
The corresponding audible alarm is a 5-tone sequence that sounds twice and is repeated every 7 seconds.

Caution = medium priority message

- 3 The yellow light flashes.
Caution messages are marked with two (2) exclamation marks.
Example: **!! Check settings**
The corresponding audible alarm is a 3-tone sequence that is repeated every 20 seconds.

Advisory = low priority message

- 3 The yellow lamp remains constantly lit.
Advisory messages are marked with one exclamation mark.
Example: **! Fan malfunction**
The corresponding audible alarm is a 2-tone sequence that sounds only once.

If the loudspeaker for the audible alarm fails due to a component defect, a continuous tone is emitted by an auxiliary alarm.

The same continuous tone is also used to indicate a power failure, see page 42, if there is a break in the power supply.

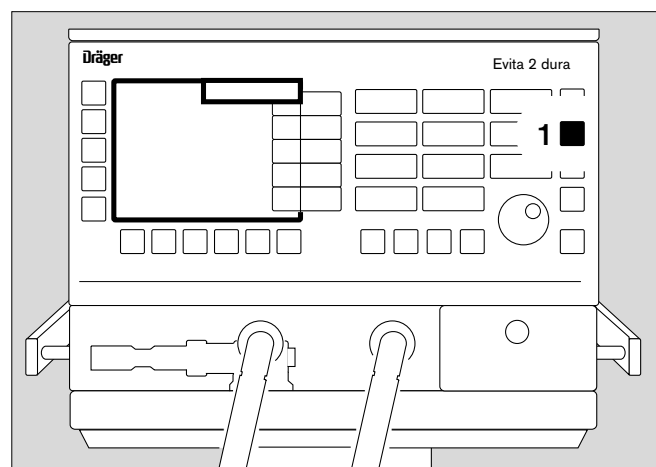
To remedy any faults, please refer to chapter "Troubleshooting", starting on page 118.

Once a fault condition has been remedied, the audible alarm will be switched off. Caution and Advisory messages will disappear automatically.

Warning messages (!!!) will then appear in the color of the status field and must always be acknowledged:


- 1 Press »Alarm Reset« key.

The message is erased from the screen.




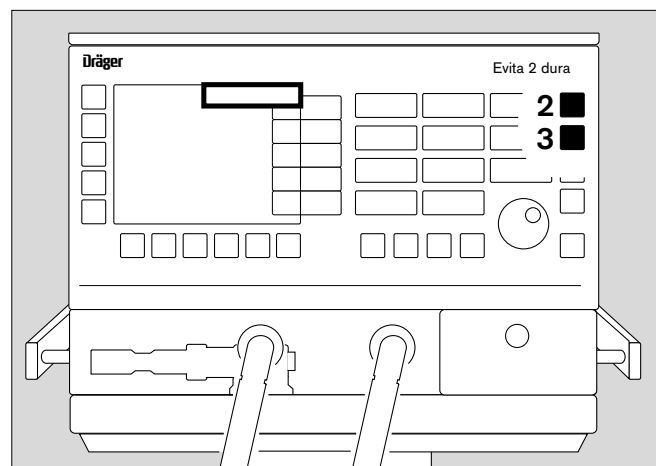
Silencing Audible Alarms

for max. 2 minutes:

- 2 Press »« key, the yellow indicator LED will be lit. The audible alarm will be silenced for 2 minutes. If the fault that triggered the alarm persists, the audible alarm will start again after that time.

If you wish to reactivate the audible alarm temporarily:


- 2 Press »« key, the yellow LED will be switched off. The message remains on screen.
- 3 Press »Alarm Reset« key for those alarms that can be acknowledged via Alarm Reset, see "Troubleshooting, page 118.




WARNING !

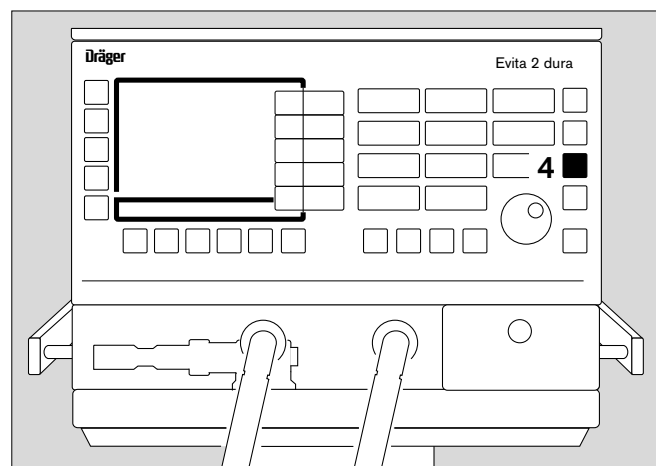
The alarm silence key is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilation and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury

Using Help

- For help with operating the ventilator system
 - For help with troubleshooting.
- 4 Press »« key: information is displayed in the bottom line of the screen.

To cancel on-screen help:

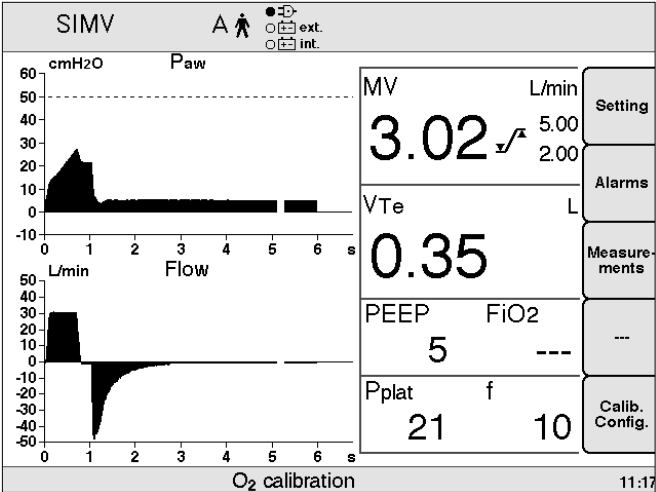
- 4 Press »« key again.



Displaying Waveforms and Measured Values

On the Main Page

A group of six selectable measured values are displayed in the right-hand field, with two selectable waveforms in the left-hand field.



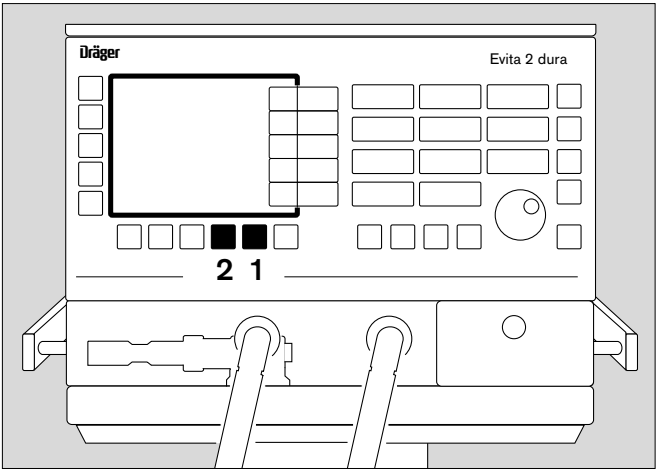
To select a second group of 6 measured values:

- 1 Press the »Values 1 2« key.

To select another pair of waveforms:

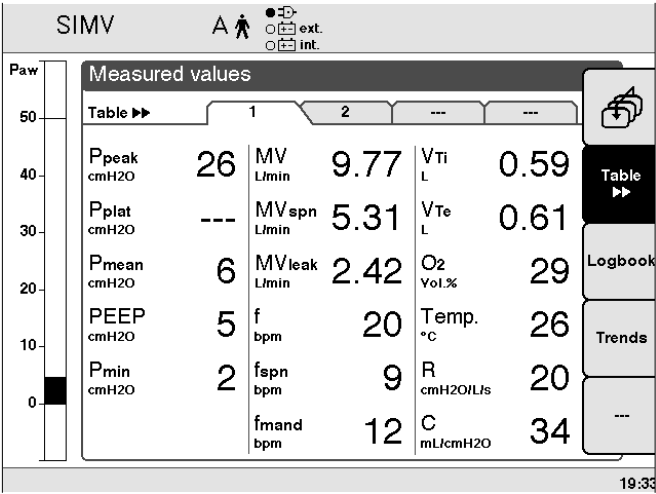
- 2 Press the »Waves « key.

Measured values and waveforms can be preselected, see "Selecting Measured Values Combinations for Display", page 95, and "Selecting Waveforms to be Displayed", page 96.



In the other screen pages, these waveforms and measured values are not displayed. Instead, an analog bar graph continuously shows airway pressure on the left-hand side of the screen.

Example: Screen page "Measured Values, Table 1"



Measured Values Overview

- Press »Measured values« key.

Display example: »Table 1«

All the measured values and measurement units are displayed in table format. »Table 1« is the factory-set default display.

The measured value MV_{leak} shows leakage in L/min. This value is determined by Evita 2 dura by comparing delivered inspiratory minute volume to minute volume measured on the expiratory side.

Evita 2 dura uses the value for MV_{leak} to automatically correct the applied tidal volume VT_i and of the flow and volume curve. Prerequisite: leak compensation is switched on, see page 102. For safety reasons, measured values for minute volume are not corrected.

Measured values			
P _{peak} mbar	34	MV L/min	4.15
P _{plat} mbar	30	MV _{spn} L/min	1.31
P _{mean} mbar	9	MV _{leak} L/min	0.00
PEEP mbar	4	f bpm	11
P _{min} mbar	3	f _{spn} bpm	7
O ₂ Vol. %	30	f _{mand} bpm	4
		VT L	.447
		VT _e L	.447
		VT _{P.s.} L	.363
		Temp. °C	---
		R mbar/L/s	8.9
		C mL/mbar	17.8

To display values measured by available options (e.g. "Evita 2 dura CapnoPlus"):

- Select »Table 2« with the »Table ►« key. Additional tables display measured values of optional extended monitoring, e.g. CapnoPlus CO₂ monitoring.

Optional (SW 4.n plus) parameters rendered

VTP.S., inspiratory tidal volume during a pressure support breath

RSB, Rapid Shallow Breathing index¹⁾

NIF, Negative Inspiratory Force index²⁾

Measured values			
P _{peak} mbar	12	MV L/min	10.7
etCO ₂ kPa	---	MV _{spn} L/min	10.7
		VT L	.185
		VT _e L	.178
		VT _{P.s.} L	.185
V _{ds} mL	---	RSBI 1/(min ⁴ L)	194
V _{ds} /VT _e %	---	NIF mbar	-18
ψCO ₂ mL/min	---	05:15	
		04/26/00	

1) For a detailed description of RSB, see "Theory of Operation" page 154.

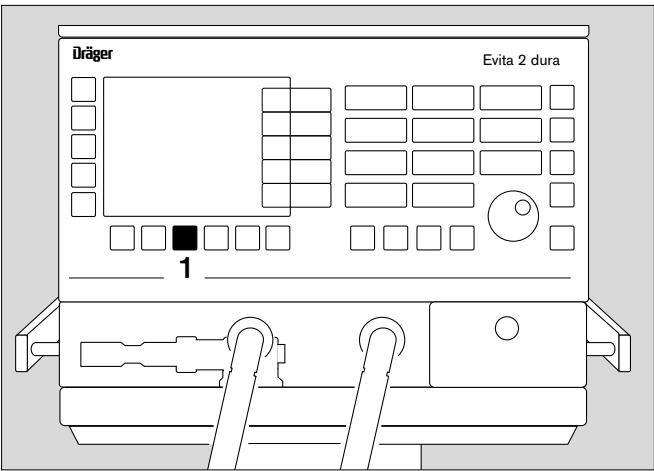
2) For a detailed description of NIF, see "Theory of Operation" page 154.

Application of NIF, see "Manually Timed Expiration", page 79.


Freezing Waveforms

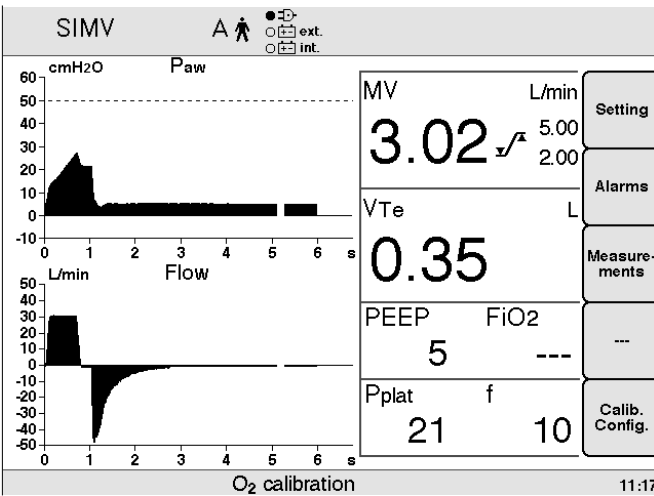
To study waveform(s) in more detail:

- 1 Press »Freeze  « key.



For displaying new waveform(s) again:

- 1 Press »Freeze  « key again.



Special Functions

Manually Timed Breaths (Inspiratory Hold)

This function can be used in all modes except CPAP without Pressure Support.

Depending on the start time, an automatic ventilator breath is either prolonged for a maximum of 15 seconds, or,
a new ventilator breath is manually started and held for max. 15 seconds between two automatic ventilator breath.

The pattern of a manually started Inspiration Hold is determined by the ventilation mode used.

For CMV, SIMV and MMV:

The volume controlled ventilator breath is defined by V_T and T_{insp} settings.

For PCV+:

the pressure-controlled ventilator breath is defined by P_{insp} and T_{insp} setting.

For CPAP/PSupp.

the pressure-controlled ventilator breath is defined by $P_{\text{Supp.}}$ setting.

- 1 Press and hold »**Insp. hold**« key for as long as inspiration is required.

Either an already activated automatic ventilator breath will be prolonged or a new ventilator breath will be started and appropriately prolonged – max. 15 seconds.

NOTE: Inspiration Hold cannot be activated again before a refractory time of 15 seconds has elapsed.

Manually Timed Expiration (Expiratory Hold)

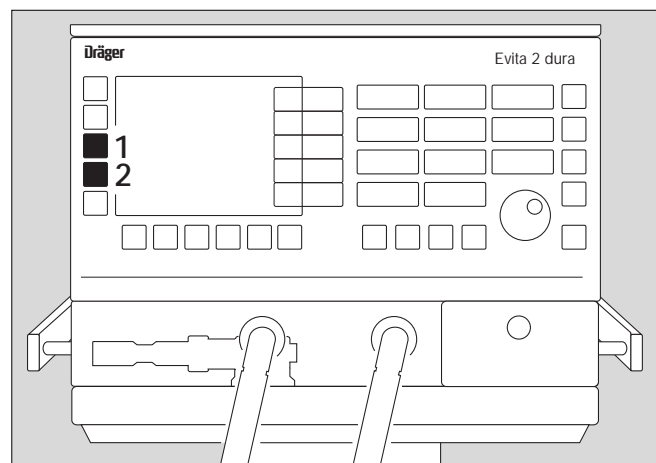
Operates in all ventilation modes.

Used to determine the weaning parameter NIF¹⁾

- 2 Press and hold »**Exp. hold**« key.

Expiration is maintained as long as the key is held down and Evita 2 dura determines the value of NIF.

After 15 seconds, the ventilator will automatically interrupt expiration.



1) For a detailed description of optional (SW 4.n plus) parameter NIF, see "Theory of Operation", page 154.

Nebulizing Aerosols

During ventilation in adult mode

Nebulizer may be used in all ventilation modes.

Evita 2 dura administers the medicated aerosols synchronized with inspiration, while automatically maintaining the preset minute volume.

Depending on the O₂ concentration set, the ventilator supplies the nebulizer with air, oxygen, or a mixture of air and oxygen. Deviations from the set O₂ concentration are thus kept as low as possible.

NOTE: In extreme cases (with a minimum inspiratory flow of 15 L/min), the deviations can be up to $\pm 4 \text{ Vol. \%}^*$. In order to avoid greater deviations, the nebulizer is switched off at inspiratory flows below 15 L/min.

During ventilation in pediatric mode

Nebulizing of medicated aerosols is possible in pressure controlled ventilation modes.

In volume controlled ventilation modes nebulizing is only possible while using the AutoFlow® add-on (available option).

In contrast to nebulizing in adult patient mode, aerosol is delivered continuously in pediatric mode. Aerosol generated during expiration will not, however, reach the lung.

Depending on the O₂ concentration set, the ventilator supplies the nebulizer with air, oxygen, or a mixture of air and oxygen. Deviations from the set O₂ concentration are kept as low as possible.

NOTE: It is recommended not to use the nebulizer while ventilating at breath rates below 12 bpm.

For breath rates above 12 bpm, consult the diagram on page 155 for delivered O₂ concentration.

The maximum deviation from set O₂ concentration is $\pm 4 \text{ Vol. \%}^*$.

WARNING !

When using the nebulizer breath rates below 12 bpm, deviations from set oxygen concentration can be significantly higher in extreme cases.

These deviations cannot be monitored by the internal O₂ analyzer of the ventilator.

* For a detailed description of the inspiratory O₂ concentration when nebulizing, please refer to "Theory of Operation", page 155.

After 30 minutes, the ventilator will switch nebulizer off automatically.

After the delivery of aerosol, the flow sensor is automatically cleaned and calibrated, in order to prevent any malfunction in the flow monitoring system.

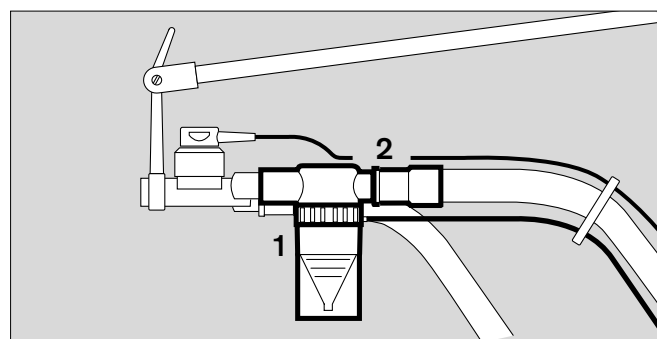
Prepare nebulizer in accordance with its Instructions for Use.

WARNING !

The integrated nebulizer function of Evita 2 dura is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause deviations in tidal volume and inspiratory O₂ concentration!

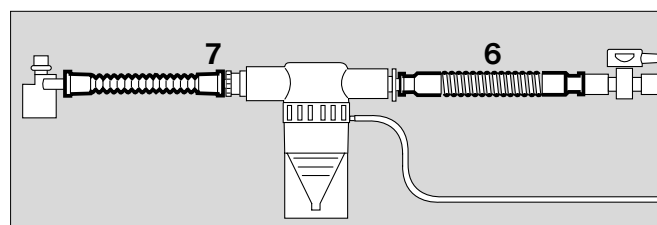
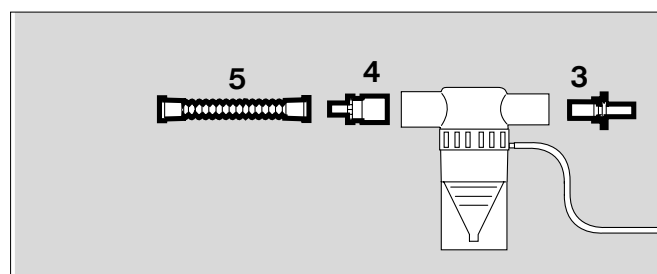
For use while ventilating adults

- 1 Connect nebulizer to inspiratory side (temperature sensor side) of the Y-piece.
- 2 Connect inspiratory circuit to nebulizer.
- Place nebulizer in a vertical position.
- Using clips supplied with patient circuits, route nebulizer hose back to the ventilator along the expiratory circuit.



For use while ventilating children and infants

- 3 Insert tapered adapter (ISO Ø15 / Ø11) into nebulizer entry port.
- 4 Insert tapered adapter (ISO Ø22/ Ø11) into nebulizer output port.
- 5 connect corrugated silicone circuit segment (part no. 84 09 634, 0.13 m) to the nebulizer output port.
- 6 Remove corrugated patient circuit element from the inspiratory port on the Y-piece and connect to the inspiratory port of the nebulizer instead.
- 7 Attach the free end of the corrugated circuit installed to the expiratory port of the nebulizer to the inspiratory port of the Y-piece.



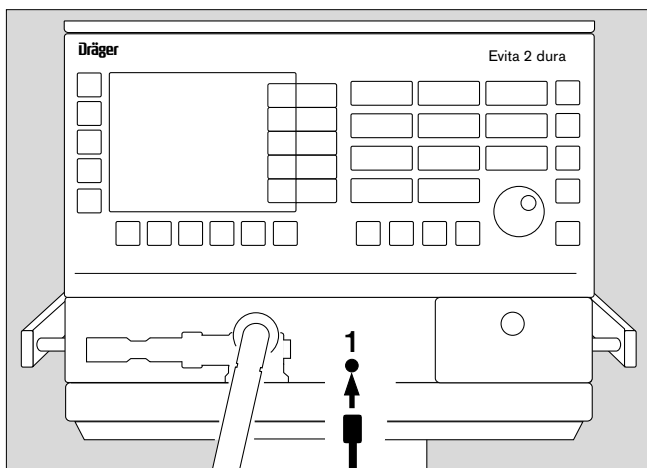
- 1 Connect nebulizer hose onto the nipple in the front of the Evita 2 dura ventilator unit.
- Fill nebulizer in accordance with its respective Instructions for Use.

WARNING !

Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)!
The measuring function of the flow sensor may be impaired.

The flow resistance of filters is liable to increase and may impair ventilation.


Do not put a microbial filter on the nebulizer outlet when in use!



WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation


- 2 Hold down »  « key until the yellow LED lights up.

- Advisory message on screen:

Nebulizer on!

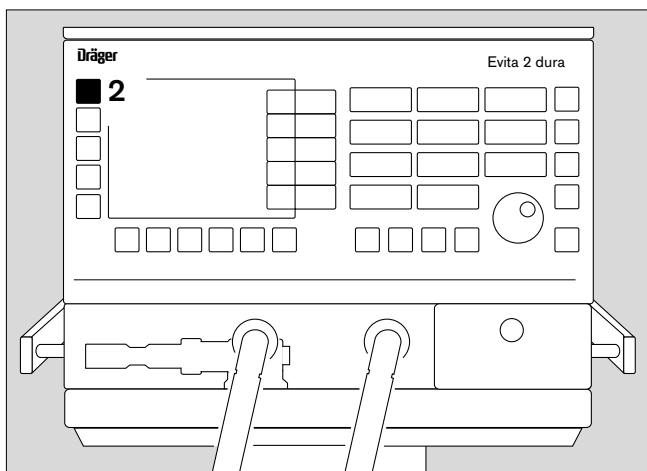
The nebulizer now operates for 30 minutes.

If nebulizing needs to be stopped early:

- 2 Press »  « key again. The yellow LED will go out and the nebulizer is switched off.

The flow sensor is then automatically cleaned and calibrated.

- Remove any leftover nebulizing solution. Clean nebulizer according to its Operating Instructions.



Pre-/Post-Oxygenation for Bronchial Suction

To avoid any risk of hypoxia during bronchial suction, Evita 2 dura offers a program for elevated oxygenation during the removal of secretions.

Evita 2 dura ventilates patients in the set ventilation mode with elevated oxygen concentrations for 180 s. Pre-oxygenation levels are 100 Vol.% oxygen when in adult mode and a concentration 25 % higher than the setting when in pediatric mode (example: if 60 Vol.% O₂ is set, 75 Vol.% is applied).

When the ventilator is disconnected for suction, Evita 2 dura interrupts ventilation. During the time suction is performed audible alarms are silenced in order to not disturb the routine.

After suction is complete and the ventilator has been reconnected, Evita 2 dura supplies elevated oxygen concentrations for 120 seconds as post-oxygenation. Oxygen levels are 100 Vol.% O₂ for adults and a concentration 25 % higher than the setting in pediatric mode. During suction and for 2 minutes afterwards, the lower alarm limit for the minute volume is switched off.

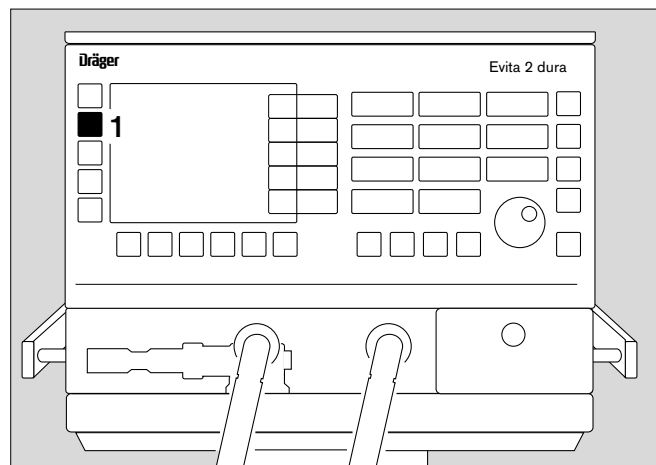
Before suction

- 1 Hold down the »O₂ ↑ Suction« key until the yellow LED lights up.
Evita 2 dura now operates in the set ventilation mode at an elevated oxygen concentration (100 Vol.% O₂ when in adult mode and a concentration 25 % above the setting when in pediatric mode).
Unless PEEP has been set to more than 4 cmH₂O, PEEP will be automatically applied at 4 cmH₂O. This PEEP will enable Evita 2 dura to detect the subsequent disconnection.
The other ventilation parameters remain unaffected.

- Display in the help line at the bottom edge of the screen:

O₂ enrichment 180 s

The remaining time is continuously displayed.
Pre-oxygenation lasts for a maximum of 180 seconds.
During this time, Evita 2 dura waits for the disconnection associated with suction.
If no disconnection is detected within 180 seconds, the oxygenation program is automatically terminated.



After disconnection for suction

For the duration of the disconnection, Evita 2 dura delivers a minimal flow at 100 Vol.% O₂ when in adult mode or at an O₂ concentration 25 % higher than the setting when in pediatric mode. This minimal flow is used for automatic detection of the disconnection phase. In the Help line at the bottom of the screen, the time available for suction is displayed as a continuous countdown in seconds (example):

Execute suction and reconnect 120 s

If suction is terminated and the ventilator reconnected within the allowed time window, Evita 2 dura returns to ventilating and post-oxygenation, see below. The MV_{total} ✓ and P_{aw} ✓ alarms are silenced.

Automatic interruption of oxygenation program

If there is still no reconnection detected after 120 seconds, the oxygenation program is canceled. All alarms are immediately reactivated. Evita 2 dura then immediately continues ventilating in the set ventilation mode.

After reconnection

After successful reconnection in the allowed time window, Evita 2 dura returns to ventilating in the set ventilation mode, but for the first 120 seconds after reconnection it continues to supply an elevated oxygen concentration as post-oxygenation (100 Vol.% O₂ when in adult mode or an O₂ concentration 25% higher than the setting when in pediatric mode).

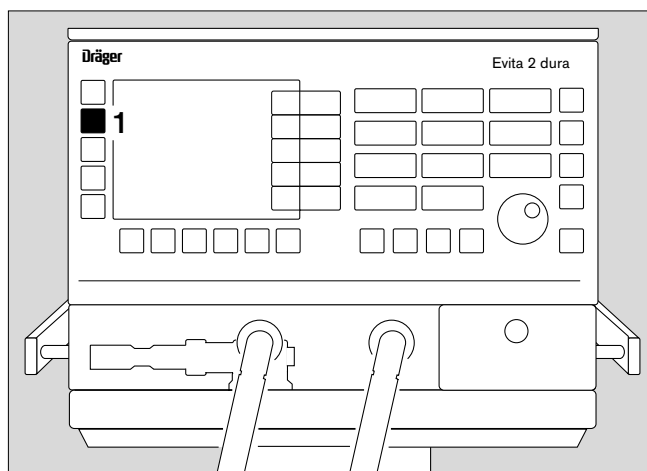
- Message in the help line at the bottom of the screen:

Final O₂ enrichment 120 s

The time remaining is displayed continuously.

If you need to cancel the oxygenation program:

- 1 Press the »O₂ ↑ Suction« key again.



Selecting Standby Mode


NOTE: No ventilation takes place in standby mode!

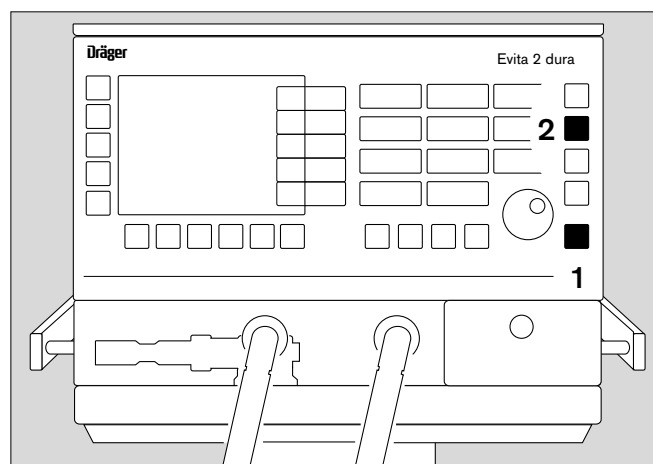
Uses of Standby:

- to select the patient mode
- to perform the ventilator check
- to maintain Evita 2 dura ready for operation
- to preset ventilation parameters and alarm limits.

Switching to standby

- 1 Hold down »Standby« key for approximately 3 seconds.
The Standby audible alarm will sound.
- 2 The »Alarm Reset« key can be used to switch off the Standby audible alarm.

NOTE: The Standby alarm cannot be silenced with
»« key.

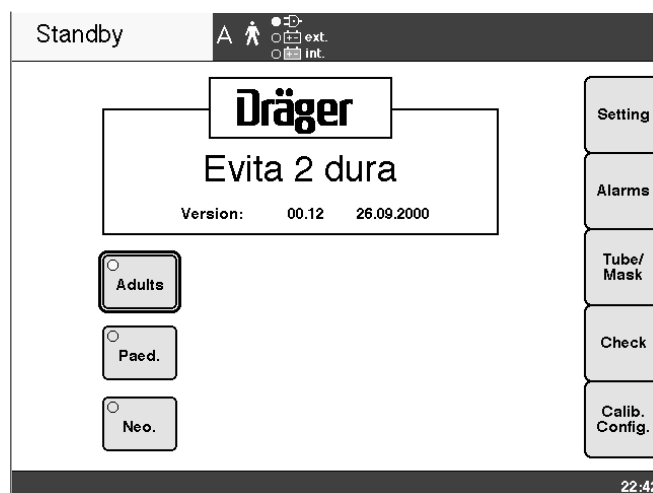


Ending standby mode

- to continue ventilation.
- 1 Press »Standby« key.
The LED goes out, ventilation starts.

If the patient mode is changed while the ventilator is in standby mode, new default ventilation parameters are calculated, see page 100.

Display (example):



Calibrations

NOTE: The last calibration values remain stored until the next calibration, even when the ventilator is switched off.

Calibration of the pressure sensors for measuring airway pressure is performed automatically.

An automatic calibration of flow and O₂ sensor is performed daily.

Manual calibration of the flow sensor and the O₂ sensor may be performed at any time, even during ventilation.

Manually Calibrating the O₂ Sensor

- Before operation, during the ventilator check.
- After replacing the O₂ sensor (wait until after 15-minute warm-up of the O₂ sensor).
- If measured value and setpoint deviate from each other by more than 2 Vol.%.

The O₂ sensor can be calibrated during ventilation. This will not affect the applied O₂ concentration.

Verify that the ventilator is supplied with O₂.

Start calibration:

- Press »**Calib./Config.**« menu key.
- Turn dial knob to select »**O₂**« screen key.
- Press dial knob to start »**O₂**« calibration.

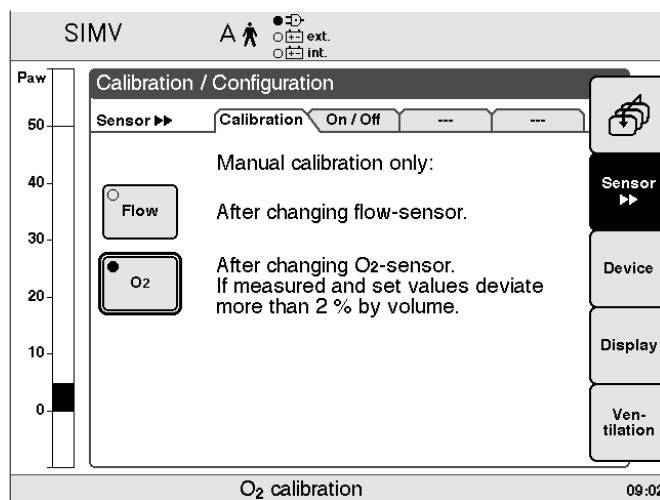
Display (example):

Message in the help line at the bottom of the screen:

O₂ calibration

After successful calibration, the following message appears in the help line:

Calibration ok



Manually Calibrating the Flow Sensor

- Before operation, during the ventilator check.
- After replacing the flow sensor.

After using the nebulizer, the flow sensor is automatically cleaned and calibrated.

WARNING !

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors after disinfection).

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

To start calibration:

- Press »Calib./Config.« key.
- Turn dial knob to select »Flow« screen key.
- Press dial knob to start flow calibration.

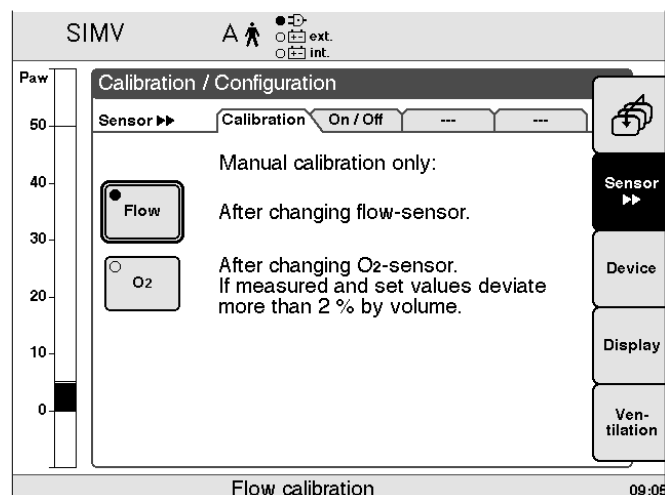
Display (example):

Message in the help line at the bottom of the screen:

Flow calibration

After successful calibration, the following message appears in the help line:

Calibration ok



External Flow Source

Whenever a constant, external flow up to 12 L/min is added (e.g. when operating a nebulizer from an external gas source and not from the Evita 2 dura nebulizer gas supply), Evita 2 dura is able to take this flow into account and to increase the thresholds for flow sensor monitoring. This helps to avoid "Flow measurement inop." or "Neo.flow measuring fault" (Option NeoFlow) during these applications.

The original measurement of expiratory volume remains unchanged.

For the expiratory flow Evita 2 dura will therefore measure a correspondingly higher value for V_{Te} and MV.

In order to avoid alarms:

- Adjust upper alarm limit for MV.

To have Evita 2 dura calculate external flow:

- Press »**Calib./Config**« menu key,
- Using the»**Sensor ►►**« menu key, select »**Ext. Flow**« menu.
- Turn dial knob to select »**Measure**« screen key, press dial knob to confirm.
- The yellow "LED" in the »**Measure**« screen key is now lit.

Evita 2 dura now calculates the amount of external flow. During this calculation, the ventilator displays:

External flow will be determined

When the external flow has been calculated, Evita 2 dura will display it together with a time and date stamp.

Simultaneously, Evita 2 dura displays the message:

Confirm value with 

- Press dial knob to confirm.

Evita 2 dura cancels compensation of an external flow if it exceeds 12 L/min, or if the flow measuring function of Evita 2 dura is inoperable.

After the external flow has been successfully determined, it is taken into account for flow sensor monitoring.

The yellow "LED" in the »**extern. Flow**« screen key is lit.

As long as Evita is taking external flow into account, it shows the advisory message:

! External flow

When no external flow is applied any more:

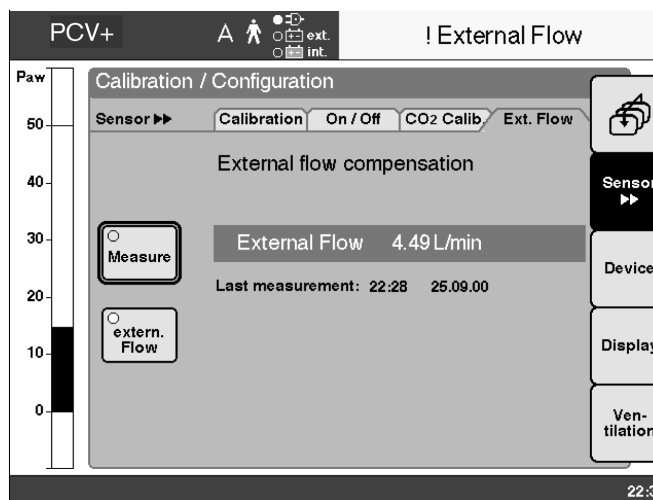
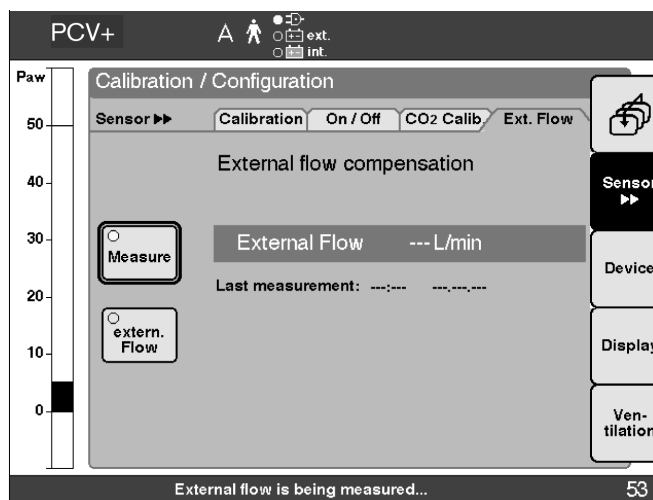
- Switch off: Turn dial knob to select »**extern. Flow**« screen key, press dial knob to confirm.

Once Evita 2 dura has determined the value of the external flow, the function can be activated at any time:

- Turn dial knob to select »**Ext. Flow**« menu, press dial knob to confirm.

In case the external flow has changed:

- Let Evita 2 dura determine the external flow via screen key »**Measure**«.



Switching Monitor Functions Off/On

e.g. if a spent sensor cannot be replaced immediately.

WARNING !

In case of malfunction of any of the built-in monitoring a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

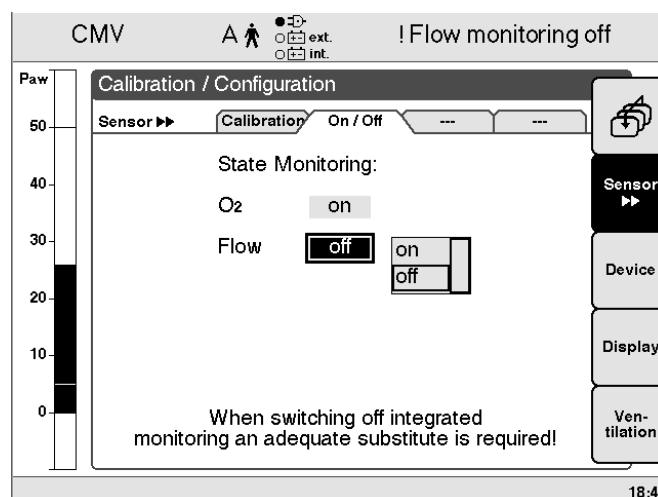
Example: Switching off Flow Monitoring.

- Press »Calib./Config.« menu key.
- Using the »Sensor ►« menu key, select »Sensor On/Off« menu.

Display (example):

- Turn dial knob to select the »Flow on« screen line, press dial knob to confirm.
- In the selection menu, turn dial knob to select »off«, press dial knob to confirm.

The respective measured values disappear.
The alarm function is switched off.



To switch the monitor function back on after replacing the sensor:

- Turn dial knob to select the »Flow off« screen line, press dial knob to confirm.
- In the selection menu, Turn dial knob to select »on«, press dial knob to confirm.

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Configuration

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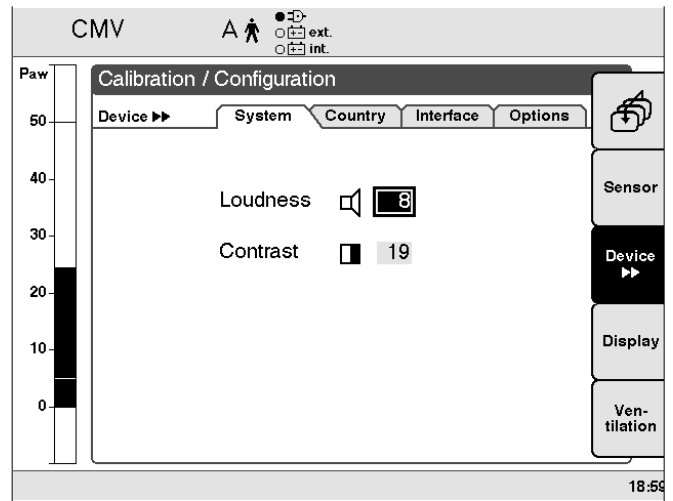
System Settings

Adjusting Volume of the Audible Alarm

- Press »**Calib./Config.**« menu key.
- Press »**Device** ►« menu key.
The »**System**« menu appears.

Display (example):

- Turn dial knob to select »**Volume**« screen field.
Press dial knob to activate.
- Turn dial knob to set the desired volume.
Press dial knob to confirm.
- After the setting has been confirmed, the audible alarm will sound once to enable you to judge the set volume.



Adjusting Screen Contrast

NOTE: Contrast adjustments are not possible with all available types of screens.

- Press »**Calib./Config.**« menu key.
- Press »**Device** ►« menu key.
The »**System**« menu is displayed.
- Turn dial knob to select »**Contrast**« field on the screen.
Press dial knob to activate.
- Turn dial knob to set the desired screen contrast.
Press dial knob to confirm.
The set contrast will now be in effect.

Country-Specific Settings

Selecting the Language

Evita 2 dura is delivered with the language preset to the local language in the customer's country (English with American nomenclature for North America).

The following languages may be selected:

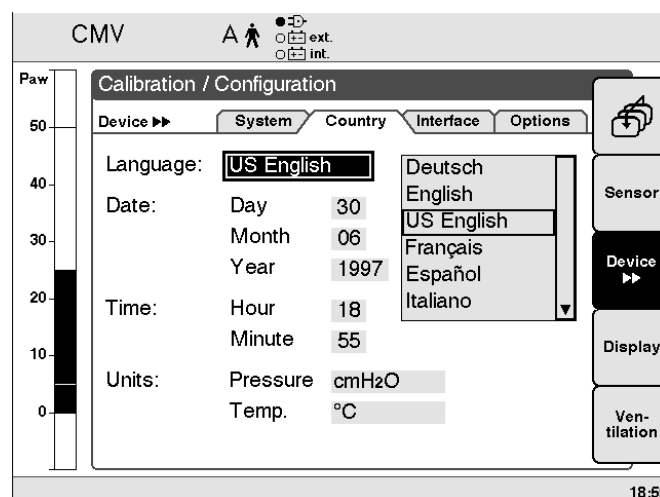
- **English** (European nomenclature)
 - **French**
 - **German**
 - **Italian**
 - **Spanish**
 - **Dutch**
 - **Swedish**
 - **US English** (American nomenclature)
 - **Japanese**
 - **Greek**
 - **Russian**
 - **Portuguese**
 - **Arabic**
 - **Chinese**
 - **Turkish**
- Press »Calib./Config.« menu key.
 - Press »Device ►« menu key.
 - With the »Device ►« menu key, select »Country« menu.

Display (example):

- Turn dial knob to select »Language« screen field, press dial knob to confirm.
- Turn dial knob to select language, press dial knob to confirm.

Setting Date and Time

- Press »Calib./Config.« menu key.
- Press »Device ►« menu key.
- With the »Device ►« menu key, select »Country« menu.
- Turn dial knob to select »Day« screen field, press dial knob to confirm.
- Turn dial knob to set date, press dial knob to confirm.
- Set month, year, hour and minutes in the same fashion.



Selecting Units of Measurement

- Press »Calib./Config.« menu key.
- Press »Device ►►« menu key.
- With the »Device ►►« menu key, select »Country« menu.

Under Units:

- Turn dial knob to select »Pressures« screen field, press dial knob to confirm.
- Set **Temp.** and **CO₂** (option) in the same fashion.

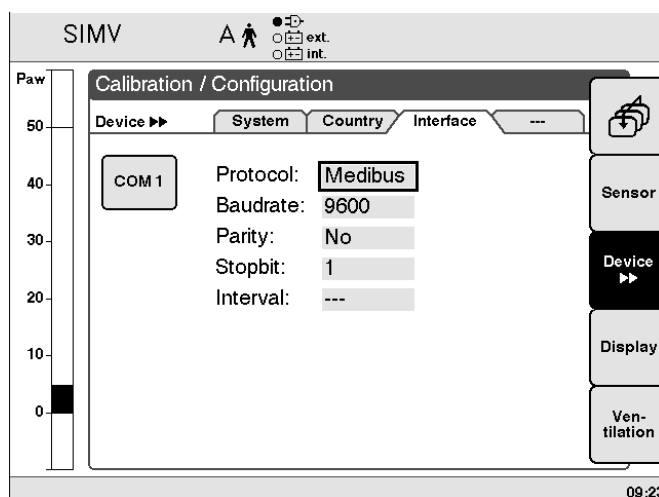
Interface

Configuring the External Interface

Evita 2 dura offers the following interface protocols:

- Printer (HP Deskjet 500 and compatible)
- MEDIBUS (Dräger communications protocol for medical devices)
- LUST (List-controlled universal interface driver program, compatible with the Evita RS 232 interface as of software version 7.n of the original Evita ventilator)

- Press »Calib./Config.« menu key.
- Press »Device« menu key.
- With the »Device ►►« menu key, select »Interface« menu.
- Turn dial knob to select the desired port with screen keys »COM1«, »COM2«, »COM3«, or »Analog«.
(COM2, COM3, and Analog available with option "Evita 4 Link")
Press dial knob to confirm.
- Turn dial knob to select the desired interface protocol in the "Protocol" screen field.
Press dial knob to confirm.
- Turn dial knob to select the screen field corresponding to the desired interface parameter, press dial knob to confirm.
- Turn dial knob to set the desired value, press dial knob to confirm.



Adapting the interface protocols:

See the Operating Instructions of the device you want to connect.

For the printer protocol:

Baud rate

Print intervals, set as required.

For the MEDIBUS protocol:

Baud rate

Parity check bits

Number of stop bits

For the LUST protocol:

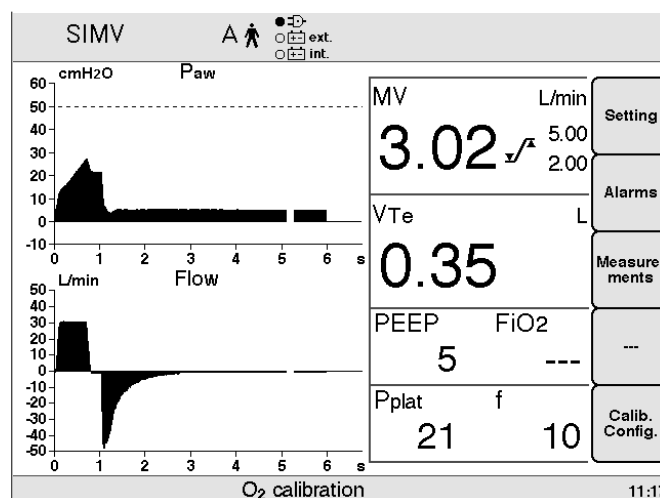
Baud rate

Screen

Selecting Measured Values Combinations for Display

Evita 2 dura displays a group of 6 selectable measured values in the right-hand field of the main page.

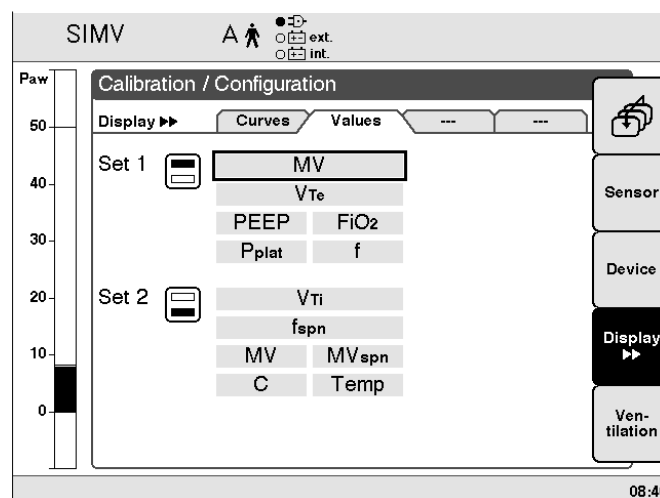
An alternative second group of values can be displayed by pressing the »Values 1□ 2□« key.



These two groups can be composed in the configuration page:

- Press »Calib./Config.« menu key.
- Press »Device« menu key.
- Select the »Values« menu with »Display ►« menu key.

Display (example):



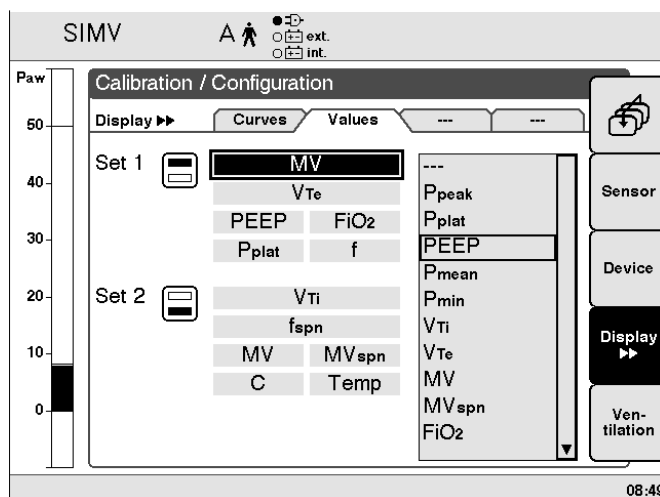
To replace one displayed measured value by another:

- Turn dial knob to select the respective screen field, press dial knob to activate.

The list from which to select all available measured values is then displayed on the right-hand side of the screen.

Display (example): Replacing P_{aw}.

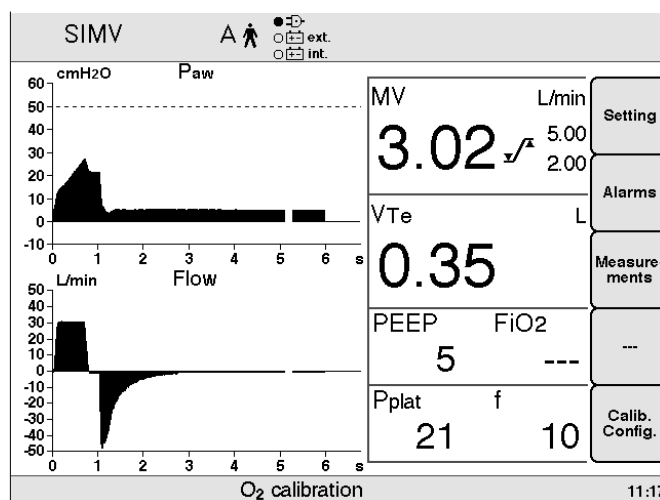
- Turn dial knob to select the other measured value, e.g. »PEEP«.
- Press dial knob to confirm.



Selecting Waveforms to be Displayed

Evita 2 dura shows two waveforms in the left-hand field of the main page.

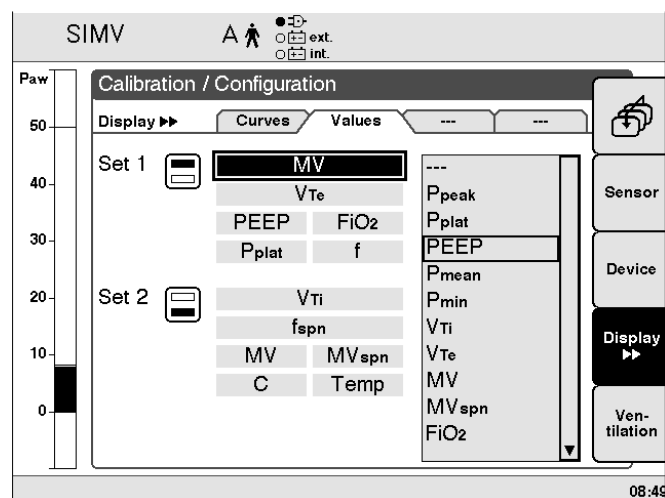
A different pair of waveforms can be selected by pressing the »Waves  « key.



The waveform pairs can be combined as required.

- Press »Calib./Config.« menu key.
- Press »Display« menu key.
- The »Waveforms« menu appears.

Display (example):



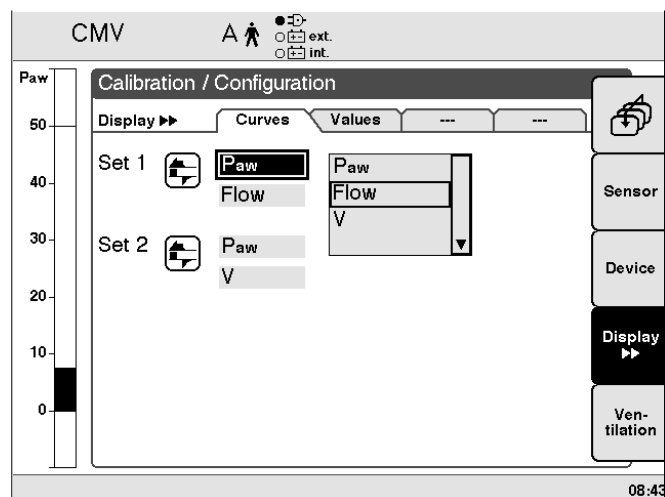
To replace a waveform display by another:

- Turn dial knob to select the respective field, press dial knob to activate.

The list from which to select all available waveforms is displayed on the right-hand side of the screen.

Display example: Replacing P_{aw}

- Turn dial knob to select the other waveform (»Flow«), press dial knob to confirm.



Ventilation Defaults at Start-Up

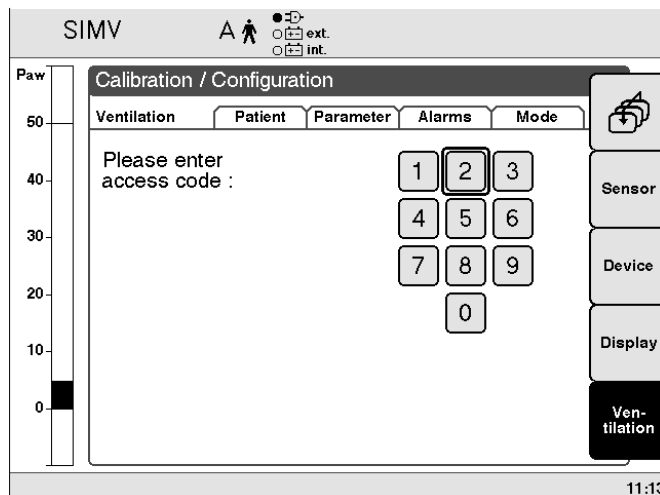
- To preset patient-specific parameters »VT« and »f« at start-up.
- To preset ventilation parameters active at ventilator start-up.
- To preset alarm limits active at ventilator start-up.
- To preset the default ventilation mode.

The »Ventilation« menu for the default settings active on starting ventilation can only be accessed after entering the code number 3032.

This code-protection is intended to prevent accidental changes to the configuration.

WARNING !

Configuration of ventilation modes and default parameters should only be performed by staff authorized by a hospital protocol.



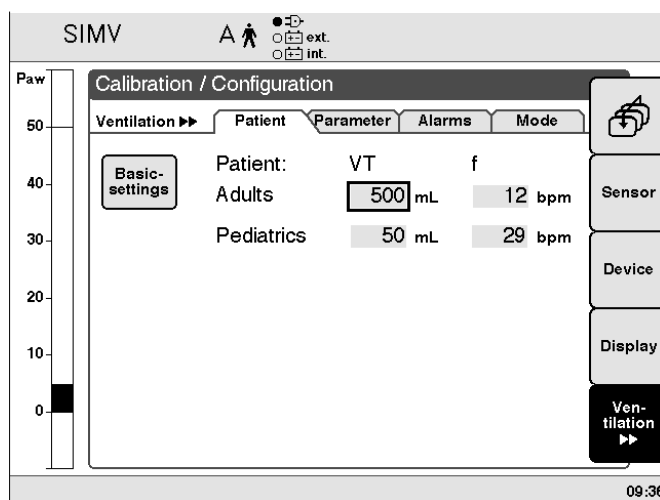
Patient-Specific Defaults

For Adult or Pediatric mode

- To set the values of parameters »VT« and »f« active at ventilator start-up.
- Press »Calib./Config.« menu key.
- Press »Ventilation« menu key.
- Enter code number »3032«.
- The »Patient« menu is now displayed.

Display (example):

- Turn dial knob to select »VT« screen field, press dial knob to confirm.
- Turn dial knob to set the desired value, press dial knob to confirm.



Patient-specific defaults VT, f:

Patient mode	Factory-set		Hospital-specific settings*	
	Tidal volume VT mL	Ventilator rate f bpm	Tidal volume VT mL	Ventilator rate f bpm
Pediatric	50	29	.....	.....
Adult	500	12	.....	.....

* Hospital selected values may be entered into the last columns for reference.

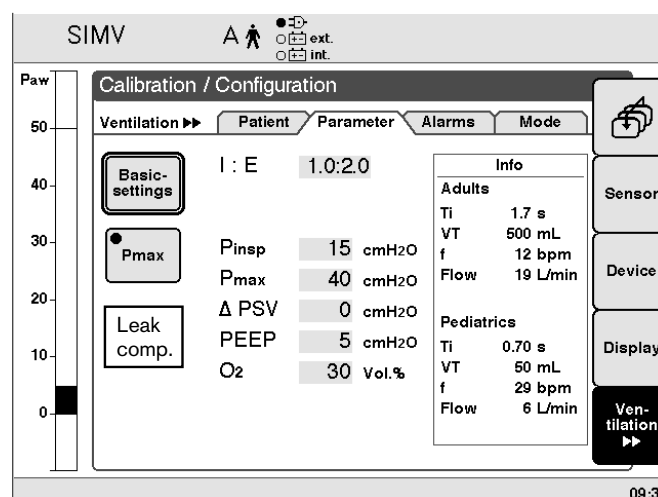
Start-Up Defaults for Ventilation Parameters

- These defaults specify the ventilation parameters and alarm limits that are not patient-specific and are activated on starting up the device.

- Press »**Calib./Config.**« menu key.
- Press »**Ventilation** ►►« menu key.
- Enter code number »**3032**«.
- Select the »**Parameter**« menu with »**Ventilation** ►►« menu key.

Display (example):

- Turn dial knob to select the desired screen field, press dial knob to confirm.
- Turn dial knob to set value, press dial knob to confirm.



Default ventilation parameters:

	I:E	P _{insp} cmH ₂ O	P _{Psupp.} cmH ₂ O	PEEP cmH ₂ O	Ramp s	Trigger L/min	O ₂ Vol. %
Factory setting	1:2	15	0	5	0.2	5	30
Hospital-specific setting*	.....	.....	.....	.....	.....	.....	.....

* Hospital selected values may be entered into the last columns for reference.

To restore the factory-set defaults:

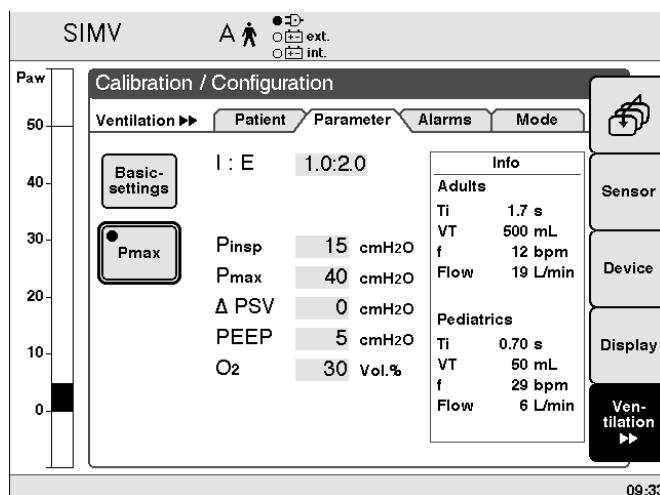
- Turn dial knob to select »**Basic settings**« screen field, press dial knob to confirm.

Activating/Deactivating Pressure Limit P_{max}

- For pressure-limited ventilation in volume controlled modes CMV, SIMV, MMV.
- Press »**Calib./Config.**« menu key.
- Press »**Ventilation ►►**« menu key.
- Enter code number »**3032**«.
- Select the »**Parameter**« menu with »**Ventilation ►►**« menu key.

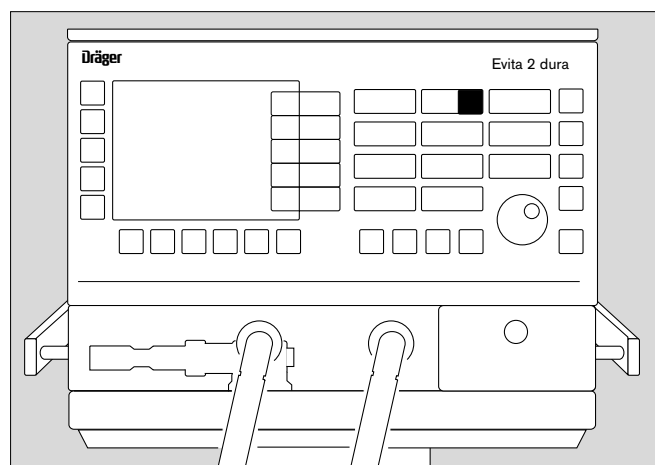
Display (example):

- Turn dial knob to select »**P_{max}**« screen key, press dial knob to activate P_{max}.
The "LED" in the »**P_{max}**« screen key now lights yellow. P_{max} is switched on.
- To switch P_{max} off, press dial knob again, the "LED" in the »**P_{max}**« screen key now lights green.



To set a value for Pmax:

- Press »**Pinsp**« parameter key.
- Turn dial knob to set the desired value, press dial knob to confirm.



Apnea Ventilation On/Off

Selects apnea backup ventilation to be ready for use at start-up.

- Press »**Calib./Config**« menu key.
- Press »**Ventilation** ►►« menu key.
- Enter code number »**3032**«.
- Select »**Parameter**« with »**Ventilation** ►►« menu key.
- Turn dial knob to select »**Apnea vent.**« screen key
- Press dial knob to activate apnea ventilation.
The "LED" in the »**Apnea vent.**« screen key now lights yellow.
- To switch apnea ventilation off, press dial knob again, the "LED" in the »**Apnea vent.**« screen key now lights green.

Leak Compensation On/Off

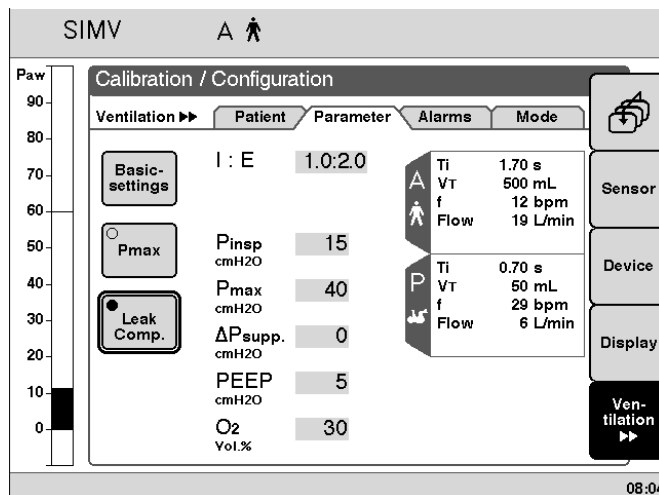
Using the automatic leak compensation, the ventilator will compensate leaks of up to 100% of the set tidal volume in all volume controlled ventilation modes.

The selection made for "Leak compensation On/Off" will remain stored and effective upon restarting the ventilator.

- Press »**Calib./Config.**« menu key.
- Press »**Ventilation ►►**« menu key.
- Enter code number »**3032**«.
- Select »**Parameter**« with »**Ventilation ►►**« menu key.

Display (example):

- Turn dial knob to select »**Leak comp.**« screen key
- Press dial knob to activate apnea ventilation.
The "LED" in the »**Leak comp.**« screen key now lights yellow.
- To switch apnea ventilation off, press dial knob again, the "LED" in the »**Leak comp.**« screen key now lights green.

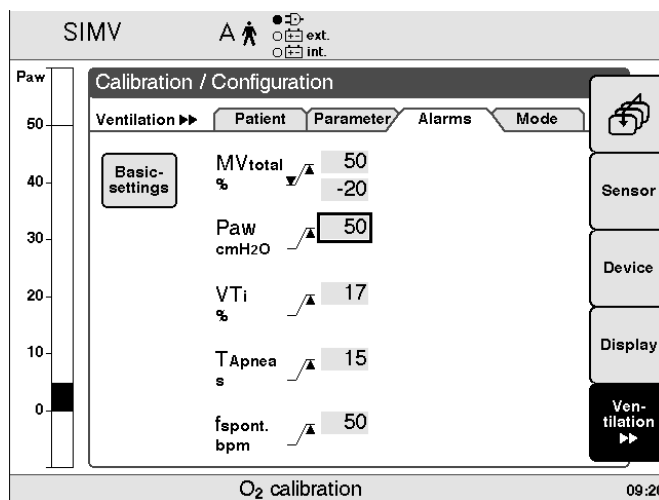


Default Alarm Limits

- Press »**Calib./Config.**« menu key.
- Press »**Ventilation ►►**« menu key.
- Enter code number »**3032**«.
- Select »**Alarms**« with »**Ventilation ►►**« menu key.

Display (example):

- Turn dial knob to select screen field of the desired alarm threshold, press dial knob to confirm.
- Turn dial knob to change value of the alarm threshold, press dial knob to confirm.



Default alarm limits

Ventilation parameters	Factory-set defaults	Hospital-set defaults*
MV_{total} $\sqrt{\text{A}}$ L/min	$MV_{total} +50 \%$ $MV_{total} -20 \%$	.... ....
P_{aw} $\sqrt{\text{A}}$ cmH ₂ O	50	....
V_{Ti} $\sqrt{\text{A}}$ mL	$V_{Ti} + 100 \%$	....
T_{Apnea} $\sqrt{\text{A}}$ s	15	....
f_{spont} $\sqrt{\text{A}}$ bpm	50	....

* Hospital selected values may be entered into the last column for reference.

No lower alarm limit for airway pressure P_{aw} needs to be set, because it is automatically linked to the PEEP setpoint.

No alarm limits need to be set for O₂ concentration, because they are automatically linked to the setpoint of O₂ concentration.

Lower alarm limits:

set value -4 Vol.% O₂ (setpoints up to 60 Vol.%)

set value -6 Vol.% O₂ (setpoints from 60 to 100 Vol.%)

Upper alarm limits:

set value +4 Vol.% O₂ (setpoints up to 60 Vol.%)

set value +6 Vol.% O₂ (setpoints from 60 to 100 Vol.%)

To restore the factory-set defaults:

- Turn dial knob to select »**Basic Settings**« screen field, press dial knob to confirm.

Default Ventilation Mode at Start-Up

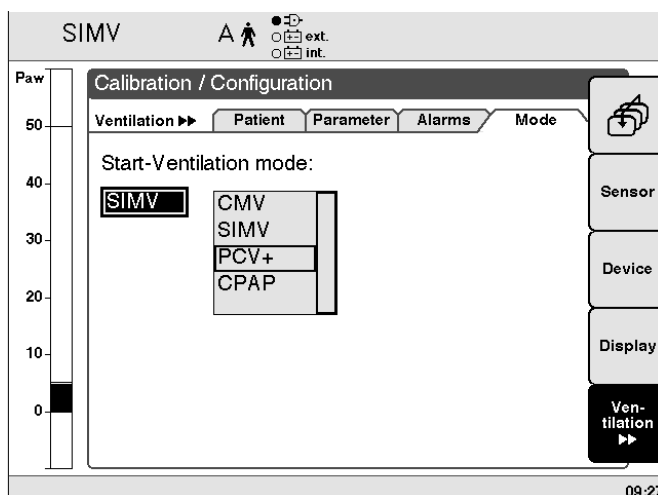
After switching on, Evita 2 dura starts up in the ventilation mode displayed in the screen key selected here. Factory default setting is CMV.

If you need a different start-up ventilation mode:

- Press »**Calib./Config.**« menu key.
- Press »**Ventilation ►►**« menu key.
- Enter code number »**3032**«.
- Select the »**Mode**« menu with »**Ventilation ►►**« menu key.

Display example: SIMV

- Turn dial knob to select the screen field for the ventilation mode, and press dial knob to confirm.
The list from which to select all available ventilation modes is then displayed on the right-hand side of the screen.
- Turn dial knob to select a new ventilation mode, and press dial knob to confirm.



Care

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Dismantling

Clean and process ventilator after each patient.

Recommendation:

Change the hose system and expiration valve as needed.
Keep the replacement systems ready.

WARNING !

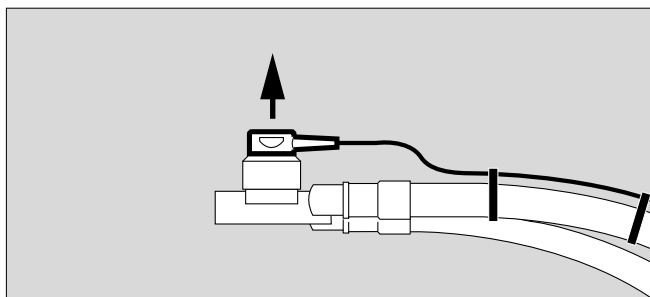
To avoid any risk of infection for hospital staff or other patients, clean and disinfect ventilator after use. Follow all accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

Removing Components

- Switch off both ventilator and humidifier, and remove their power plugs.
- Drain water traps and patient circuit.
- Drain the water container of the humidifier.

Temperature sensor (available option)

- Remove temperature sensor from Y-piece – do not pull on cable. Unplug sensor probe in the rear of the Evita 2 dura ventilator.
- The temperature sensor is designed for wipe-disinfection and may be autoclaved.

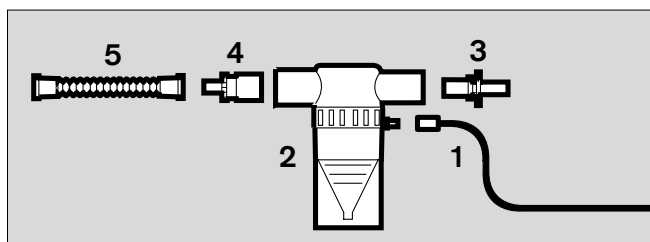
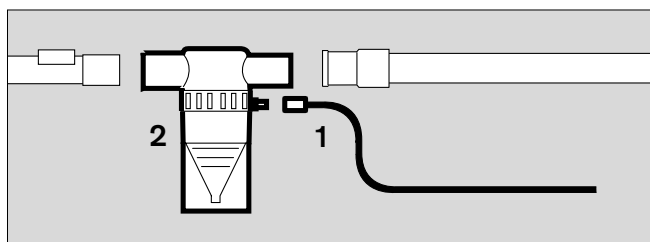


CAUTION !

Temperature sensor is not compatible with parts washer equipment or bath disinfection.

Nebulizer (available option)

- 1 Remove nebulizer hose from nebulizer and from its nipple in the front of Evita 2 dura.
 - 2 Remove nebulizer from adult patient circuit,
or
 - 2 remove nebulizer from pediatric circuit.
 - 3 Remove tapered adapter (ISO Ø15 / Ø11) from nebulizer entry port.
 - 4 Remove tapered adapter (ISO Ø22/ Ø11) from nebulizer output port.
 - 5 Remove corrugated silicone circuit segment from tapered adapter.
- Disassemble nebulizer according to its respective Operating Instructions.
 - Prepare nebulizer components and adapters for disinfection and cleaning in an automatic parts washer.



Ventilation circuit

- Remove patient circuit from connection ports.
- For reusable circuits, remove Y-piece and water traps from circuit and collecting jars from water traps.
- For reusable circuits, prepare circuit segments, water traps and their collecting jars, and the Y-piece for disinfection and cleaning in an automatic parts washer.

Flow sensor

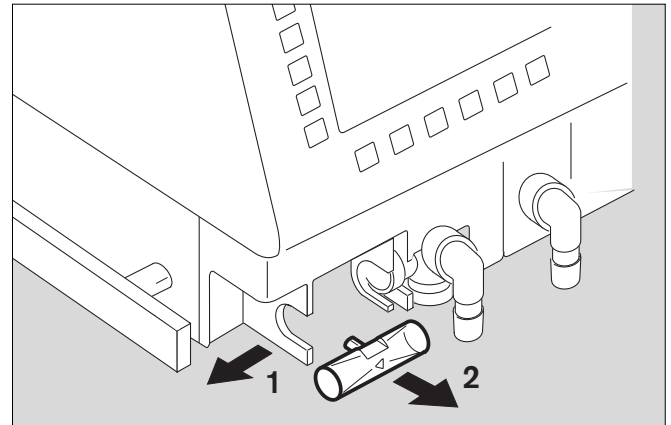
- 1 Push flow sensor to left as far as it will go and
 - 2 pull out.
- Disinfect flow sensor for about 1 hour in 70 % ethanol solution.

WARNING !

Vent flow sensor after disinfection with ethanol for at least 30 minutes. Otherwise, residual ethanol vapors might ignite and destroy the sensor during calibration.

CAUTION !

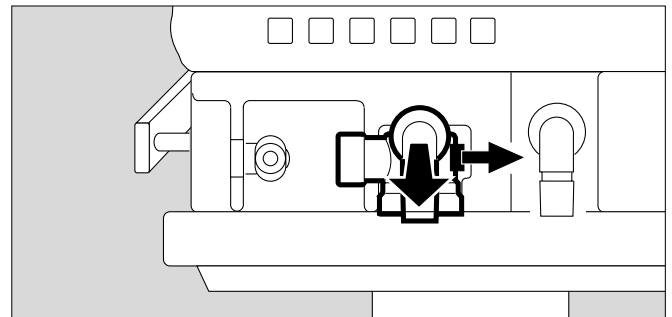
Flow sensor is not compatible with parts washer equipment and may not be autoclaved.



NOTE: The flow sensor may be reused as long as it can be calibrated successfully.

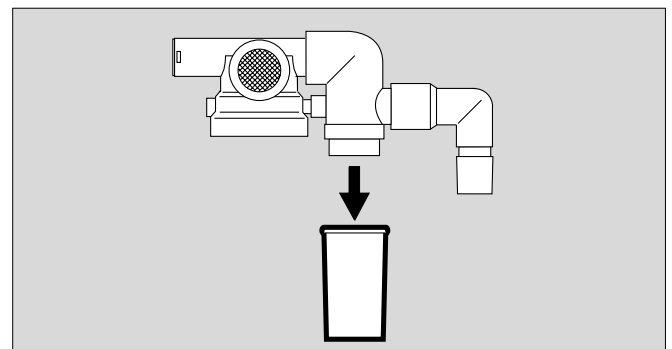
Expiratory valve

- Push catch to the right, pulling off expiratory valve at the same time.



If expiratory valve is equipped with an optional water trap:

- Remove collecting jar.



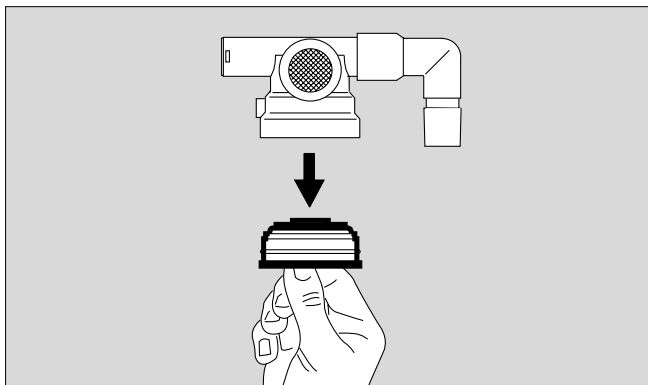
Disassemble expiratory valve only if badly soiled

- Unscrew cover lid by hand and remove together with the diaphragm.

CAUTION !

Do not disassemble expiratory valve beyond removing diaphragm!

NOTE: Expiratory valve may be disinfected and cleaned in parts washer equipment and may also be autoclaved.



Humidifier

- Disassemble and prepare for disinfection/sterilization according to its Operating Instructions.

Disinfecting/Cleaning

CAUTION !

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized.

To prevent any damage, we recommend that only detergents and disinfectants are used that are compatible with the device, e.g. surface disinfectants on the basis of aldehydes or quarternary ammonium compounds for disinfection.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times.

Disinfectants often contain – besides their main active agents – additives that can also damage materials. If in doubt, ask the supplier/manufacture of the disinfectant/cleaning agent.

For a list of materials used in the ventilator, please refer to page 142.

WARNING !

To avoid any risk of infection for hospital staff or other patients, clean and disinfect ventilator after use. Follow all accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

Ventilator With Mobile Stand, Circuit Support Arm, Gas Supply Hoses, and Temperature Sensor

- Wipe disinfect with a disinfectant based on the suggested active ingredients.
Comply with the manufacturer's instructions.

Cooling-air filter, Air-intake filter

- In the event of soiling or after 4 weeks at the latest clean or replace, see page 114.

Components of Reusable Patient Circuit and Expiratory Valve (or, in the event of severe soiling, its disassembled components)

- Disinfect in a moisture saturated environment at 93 °C (200 °F) for 10 minutes using a cleaning and disinfecting machine. **Use detergent only.**
- After disinfecting with moist heat, we recommend that the **expiratory valve or its disassembled components be autoclaved at 134 °C (273 °F) to remove any remaining liquid in the pressure measuring canal in the block.**

CAUTION !

Make sure that no liquid remains in the pressure measuring canal of the expiratory valve, since it might cause malfunction.

Alternatively, if no washing machine is available:

- **Bath disinfect** using a disinfectant based on the recommended agents.
Comply with manufacturer's instructions.

Then rinse with clean water, preferably from a demineralized water supply. Shake water out thoroughly, and leave parts to dry well.
Steam-autoclave expiratory valve afterwards.

CAUTION !

Make sure that no liquid remains in the pressure measuring canal of the expiratory valve, since it might cause malfunction.

NOTE: Reusable (silicone) patient circuit, Y-piece, water traps with their collecting jars, expiratory valve and temperature sensor are thermically stable and may be steam-autoclaved at 134 °C (273 °F).

Humidifier

- Process according to the respective Instructions for Use.

Disinfecting/Cleaning/Sterilizing Schedule

Applicable for use with non-infectious patients.

For infectious patients, all parts that are contaminated with breathing gas must be additionally sterilized after disinfecting and cleaning.

NOTE: Reusable (silicone) patient circuit, water traps and their water jars, Y-piece, expiratory valve, temperature sensor may all be autoclaved at 134 °C (273 °F). – see "Sterilizing" column.

What	How often	How			
		Disinfecting and cleaning			Sterilizing
Reusable components	Recommended cleaning intervals ¹⁾	Autoclaving at 93 °C, 10 minutes	Wiping	Immersion	Steam 134 °C, 10 minutes
Evita 2 dura ventilator	after each patient	no	outside	no	no
mobile stand, circuit support arm, gas supply hoses	after each patient	no	outside	no	no
Patient circuit, Y-piece, water traps, collecting jar	as needed	yes	no	yes	yes
Expiratory valve	after each patient weekly	yes ³⁾	no	yes	yes
Temperature sensor Flow sensor	as needed	no no	yes on the outside	no possible ²⁾	yes no

1) This table serves as a guideline only. Always follow accepted hospital procedures and guidelines for cleaning and disinfecting.

2) Special treatment, see page 107.

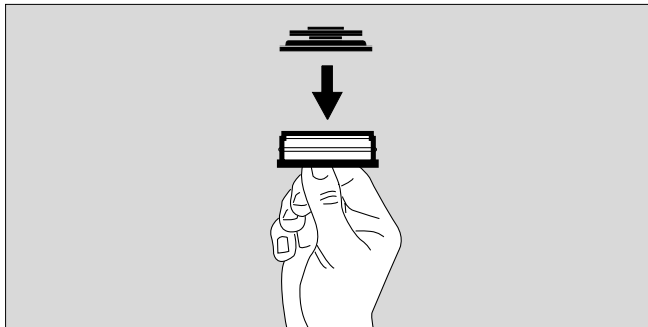
3) After disinfecting/cleaning: sterilize at 134 °C. Otherwise risk of malfunction due to residual liquid in pressure measuring line.

Assembling

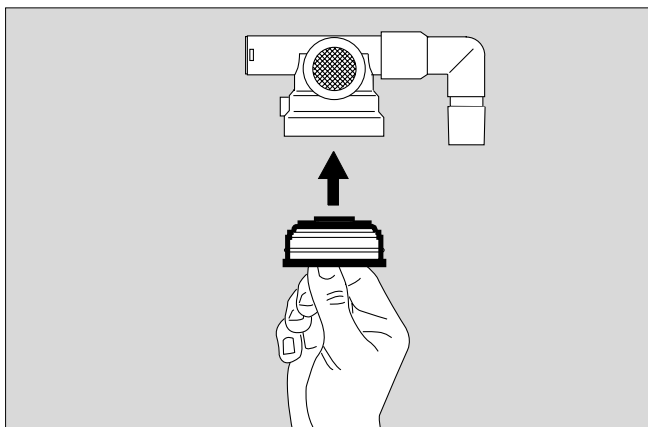
Assembling the Expiratory Valve

The parts must be entirely dry to prevent malfunctioning.

- Hold cover lid by its flange and place diaphragm on lid collar.
Be careful to install diaphragm with proper orientation.

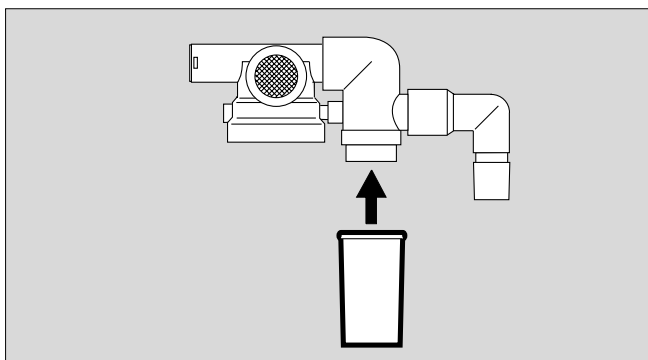


- From below, insert lid with diaphragm on top into the housing. Screw in tightly.



If the expiration valve is to be used with an additional water trap:

- Install collecting jar.



Before Reusing on a Patient

- Assemble ventilator as described under "Preparation", page 33.
- Perform all checks of readiness for operation, see "Ventilator Checks" on page 47.

Maintenance

CAUTION !

The device must be inspected and serviced at regular six months intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor.

For repairs and in any case of malfunction of the device we recommend that you contact DrägerService.

WARNING !

To avoid any risk of infection, clean and disinfect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when returning ventilators or parts for repair.

WARNING !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained or factory authorized service personnel.

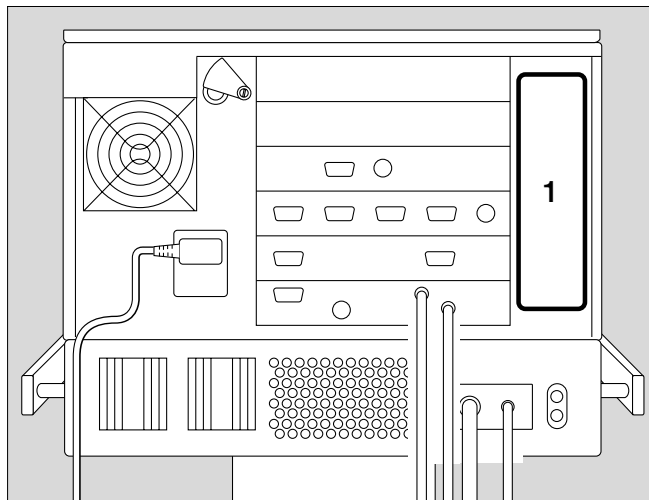
Maintenance Intervals

O ₂ sensor capsule	Replace sensor capsule in event of display message: O₂ measurement inop or if calibration is impossible. For disposal of sensor capsule, see page 114.
Air-intake filter	Clean or replace after 4 weeks, see page 114. Disposal with normal domestic waste.
Cooling-air filter	Replace at least every year. Disposal with normal domestic waste.
Filters in the compressed gas inlets	To be replaced by trained service personnel every 2 years.
Lithium battery for data backup	To be replaced by trained service personnel every 2 years. For disposal, see page 114.
Realtime clock	To be replaced by trained service personnel after 6 years. For disposal see page 114.
Pressure reducer	Complete overhaul every 6 years by DraegerService.
Preventive maintenance and service testing	Every 6 months by trained service personnel.

User-Replaceable Parts

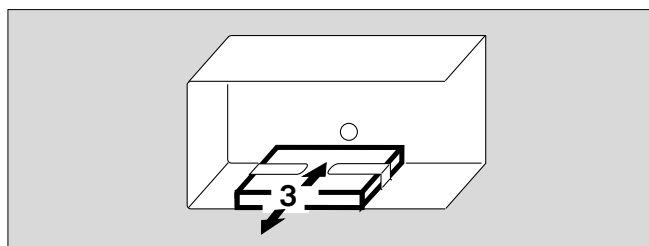
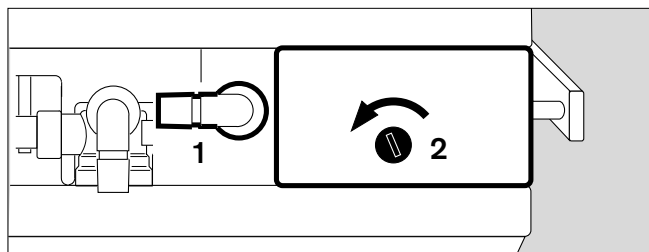
Replacing cooling air filter

- In the event of soiling or after 4 weeks at the latest clean or replace.
Replace after 1 year at the latest.
- 1 Remove cooling-air filter from its holder in the back of the ventilator.
- Replace or clean in warm water with detergent added; dry well.
- Re-insert cooling-air filter into holder. Verify that it is fit properly.
- Dispose of used cooling-air filter with domestic waste.



Removing/Installing air intake filter

- In the event of soiling or after 4 weeks at the latest clean or replace.
Replace filter every year.
- 1 If necessary, swivel inspiratory port to the left.
- 2 Loosen screw with a coin and remove protective cover.
- 3 Remove air intake filter from the protective cover.
- 3 Push new air intake filter under lugs in ventilator.
- Replace protective cover and tighten screw with a coin.
- Dispose of used air intake filter with domestic waste.



Disposal of batteries and O₂ sensors

WARNING !

Treatment of batteries and O₂-sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O₂-sensor capsules.

- Batteries must be disposed of as special waste.

Dispose of O₂ sensors in the same way as batteries. Information may be obtained from local environmental and public health authorities or from approved waste disposal companies.

Disposal of Ventilator

- at the end of its useful life

Prepare disposal of Evita 2 dura by an authorized waste disposal/recycling company after consulting with local environmental and public health authorities.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of the ventilator.

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Troubleshooting

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Troubleshooting

Alarm messages in the alarm display field are displayed in hierarchical order.

If, for example, two faults are detected at the same time, the more urgent of the two is displayed.

The priority for alarm messages (for definitions, see page 74) is indicated by exclamation marks:

Warning = Message with top priority **!!!**

Caution = Message with medium priority **!!**



Advisory = Message with low priority **!**

In the table below, the messages are listed in alphabetical order.

The table is intended to help you to identify the cause of an alarm and to ensure rapid remedy of the problem.

Message	Cause	Remedy
!!! Air supply low	Air supply pressure too low.	Make sure pressure is greater than 3 bar. (43.5 psi).
! Air supply low	Air supply pressure too low. Air supply pressure not required when $\text{FiO}_2 = 100 \text{ Vol. \%}$.	Make sure pressure is greater than 3 bar. (43.5 psi).
!! Air supply pressure high	Air supply pressure too high.	Ensure pressure is less than 6 bar (87 psi).
! Air supply pressure high	Air supply pressure too high. Air supply not required when $\text{FiO}_2 = 100 \text{ Vol. \%}$.	Ensure pressure is less than 6 bar (87 psi).
!!! Airway pressure high	The upper alarm limit for airway pressure has been exceeded. Patient is »fighting« the ventilator, cough.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
!!! Airway pressure low	Leaking cuff.	Inflate cuff and perform leak test.
	Leak or disconnection.	Check hose system for tight connections. Check that the expiration valve is properly engaged.
!!! Apnea	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
	Stenosis	Check condition of patient. Check tube.
	Flow sensor not calibrated or faulty.	Calibrate flow sensor. Replace if necessary.
!! Apnea ventilation	Due to detected apnea, the system has switched over automatically to mandatory ventilation.	Check mode of ventilation procedure. To return to the original ventilation mode, press » Alarm Reset « button.

Message	Cause	Remedy
!! Check settings	Power interruption while setting a ventilation pattern or alarm limits.	Check pattern of ventilation and alarm limits. Confirm message with »Alarm Reset« button.
!!! Device failure	Ventilator faulty.	Call DraegerService.
! Evita Remote ?	The remote control pad used was not recognized.	Remove remote pad. Acknowledge advisory with »Alarm Reset« key. Contact DraegerService at your earliest convenience.
!!! Evita Remote inop.	A key of the remote control pad was pressed during the self test of the pad.	Acknowledge advisory with »Alarm Reset« key. Detach remote pad and reconnect. Ensure that no key is pressed on the remote control during the self test.
	Remote control pad faulty.	Acknowledge advisory with »Alarm Reset« key. Disconnect remote pad . Call DraegerService.
!! Execute device check	Ventilator check not performed.	Perform ventilator check, page 49. Confirm message with »Alarm Reset« key.
! Exp. hold interrupted	The »Exp. hold« key was held down longer than 15 seconds.	Release »Exp. hold« key.
!!! Exp. valve inop	Expiratory valve not properly connected to socket.	Push expiratory valve firmly into socket until it clicks into place.
	Flow sensor not calibrated or defective.	Calibrate flow sensor, page 87, and replace if necessary.
	Expiratory valve faulty. Faulty assembly of expiratory valve.	Replace expiratory valve.
! External flow	Evita 2 dura is taking into account externally supplied flow when monitoring flow sensor function.	To switch external flow compensation off, see page 88.
!!! Failure to cycle	The device does not deliver any gas.	Check the P _{max} /PEEP setting. Set a CMV frequency of at least 4/min. Increase T _{Apnea} /° alarm time.
	Ventilator defective.	Call DraegerService.
!!! Fan failure	Fan failure.	Call DraegerService.
! Fan malfunction	Temperature inside the ventilator too high.	Check fan function, clean cooling-air filter or call DraegerService.

Message	Cause	Remedy
!!! FiO2 high	O2 sensor not calibrated.	Calibrate O2 sensor, page 86.
	Faulty mixer function.	Call DraegerService.
!!! FiO2 low	O2 sensor not calibrated.	Calibrate O2 sensor, page 86.
	Faulty mixer function.	Call DraegerService.
!!! Flow measurement inop	Flow sensor faulty.	Calibrate flow sensor, page 87, and replace if necessary.
	Flow measurement malfunction.	Call DraegerService.
! Flow monitoring off	Flow monitoring is switched off.	
!!! Flow sensor?	Flow sensor not fully inserted in rubber lip of expiratory valve.	Insert flow sensor correctly.
!! Hard key xx failed	Key xx (e.g. »  «) can no longer be pressed.	Call DraegerService.
!!! High frequency	Patient is breathing at a high spontaneous frequency (tachypnea)	Check condition of patient, Check pattern of ventilation, Correct alarm limit if necessary.
! Insp. hold interrupted	The »Insp.hold« key was held down longer than 15 seconds.	Release »Insp.hold« key.
!! Key xx overused?	Key has been pressed several times in a short period (e.g. »  «).	Confirm message with key »Alarm Reset« If this message occurs repeatedly, call DraegerService.
! Leakage	The measured leakage minute volume MV _{leak} is 20% higher than the minute volume measured on the expiration side.	Check that the hose connection is leakproof. Check that the tube is correctly fitted.
!!! Loss of data	Lithium battery discharged.	Call DraegerService.
! MEDIBUS inop.	The connector of the MEDIBUS cable was unplugged during operation.	Plug the connector in again and secure it against disconnection with the two screws.
	MEDIBUS cable defective.	Use a new MEDIBUS cable.
	Interface defective.	Call DraegerService.
!!! Mixer inop.	Mixer malfunction FiO2 can deviate considerably.	WARNING ! Immediately ventilate with separate manual ventilation device (resuscitation bag)! Call DraegerService.

Message	Cause	Remedy
Multi-function board inop !	Multifunction card operating nurse call or remote control pad is faulty.	Acknowledge message with »Alarm Reset« key. Call DraegerService at your earliest convenience. NOTE: The original ventilator functions of Evita 2 dura are not affected, the correct function of nurse call or remote control pad, however, are not warranted: Remove nurse call or remote control pad, respectively.
Multi-function board inop !!	Multifunction card operating nurse call or remote control pad is faulty.	Acknowledge message with »Alarm Reset« key. Call DraegerService at your earliest convenience. NOTE: The original ventilator functions of Evita 2 dura are not affected, the correct function of nurse call or remote control pad, however, are not warranted: Remove nurse call or remote control pad, respectively.
!!! Loss of data	Lithium battery discharged.	Call DraegerService.
!!! MV high	Minute volume has exceeded the upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
	Flow sensor not calibrated or defective.	Calibrate flow sensor, page 87, and replace if necessary.
	Water in flow sensor.	Drain water trap in patient circuit.
	Ventilator malfunction.	Call DraegerService.
!!! MV low	Minute volume has fallen below the lower alarm limit.	Check condition of patient, check ventilation pattern, correct alarm limit if necessary
	Stenosis.	Check condition of patient. Check tube.
	Leak in patient circuit system.	Establish leakproof patient circuit.
	Flow sensor not calibrated or defective.	Calibrate flow sensor, page 87, replace if necessary.
	Ventilator malfunction.	Call DraegerService.

Message	Cause	Remedy
!! Nebulization interrupted	Only in pediatric mode. Nebulization is only possible in pressure-controlled ventilation or with AutoFlow.	Select another breathing mode. Or activate AutoFlow. Restart Nebulization. Acknowledge the alarm with »Alarm Reset«.
	Flow sensor not ready for measurement. (Only in pediatric mode, only for ventilation with AutoFlow.)	Switch on flow monitoring or calibrate sensor. Restart Nebulization. Acknowledge the alarm with »Alarm Reset«.
! Nebulizer on	The nebulizer is switched on.	Switch nebulizer off if necessary, page 82.
!!! O₂ measurement inop	O ₂ sensor provides invalid measured values.	Calibrate O ₂ sensor, page 86, replace if necessary.
	O ₂ measurement malfunction.	Call DraegerService.
! O₂ monitoring off	O ₂ monitoring switched off.	Switch on O ₂ monitoring again, or immediately ensure an adequate monitor function.
!!! O₂ supply low	O ₂ supply pressure too low.	Make sure pressure is greater than 3 bar (43.5 psi).
! O₂ supply low	O ₂ supply pressure too low. O ₂ supply pressure not required when FiO ₂ = 21 Vol. %.	Make sure pressure is greater than 3 bar (43.5 psi).
!! O₂ pressure high	O ₂ supply pressure too high.	Make sure pressure is less than 6 bar (87 psi).
! O₂ pressure high	O ₂ supply pressure too high. O ₂ supply pressure not required when FiO ₂ = 21 Vol. %.	Make sure pressure is less than 6 bar (87 psi).
!!! PEEP high	Expiratory system obstructed.	Check hose system and expiration valve.
	Expiratory resistance is increasing.	Check bacteria filter. Replace if necessary.
	Ventilator defective.	Call DraegerService.
!!! PEEP valve inop	Internal PEEP valve defective.	Call DraegerService.
! Pressure limited	P _{max} pressure limit is active.	

Message	Cause	Remedy
!!! Pressure meas. inop	Fluid in expiratory valve.	Replace expiratory valve, then clean and dry, page 112.
	Pressure measurement defective.	Call DraegerService.
!!! P. Supp. > 4 s	Only appears in adult mode. The Pressure Support cycle has been switched off 3 times due to time limitation.	Test patient circuit for leaks.
! P. Supp. > 1.5 s	Only appears in pediatric mode. The Pressure Support cycle has been switched off 3 times due to time limitation.	Test patient circuit for leaks.
!!! Standby activated	Evita 2 dura has been switched to standby.	Confirm standby with »Alarm Reset« key.
	Breathing gas temperature higher than 40 °C (104 °F).	Switch off humidifier.
!!! Temperature high	Breathing gas temperature higher than 40 °C.	Switch off humidifier.
!!! Temperature meas. inop	Temperature sensor defective.	Install new temperature sensor.
!!! Temperature sensor ?	Temperature sensor probe has been disconnected during operation.	Reconnect probe.
	Sensor cable broken.	Install new temperature sensor.
!!! Tidal volume high	The upper alarm limit of the applied inspiratory tidal volume has been exceeded during three consecutive ventilation strokes.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
	Leak or disconnection.	Test patient circuit connections for leaks.
! Tidal volume high	The inspiratory tidal volume VT has exceeded the upper alarm limit.	Check condition of patient, check pattern of ventilation, correct alarm limit if necessary.
	Leak or disconnection.	Check that hose system connections are leakproof.
!!! Airway obstruction ?	Evita 2 dura is able to only apply a very small volume with each ventilator breath, e.g. due to a blocked tube.	Check patient condition, check tube
!! Volume not constant	Due to pressure limit or time limit, the set tidal volume VT has not been applied.	Prolong inspiratory time »T _{insp} « Increase inspiratory flow »Flow« Increase pressure limit »P _{max} «. Press the »Alarm Reset« key to suppress this visual and audible alarm

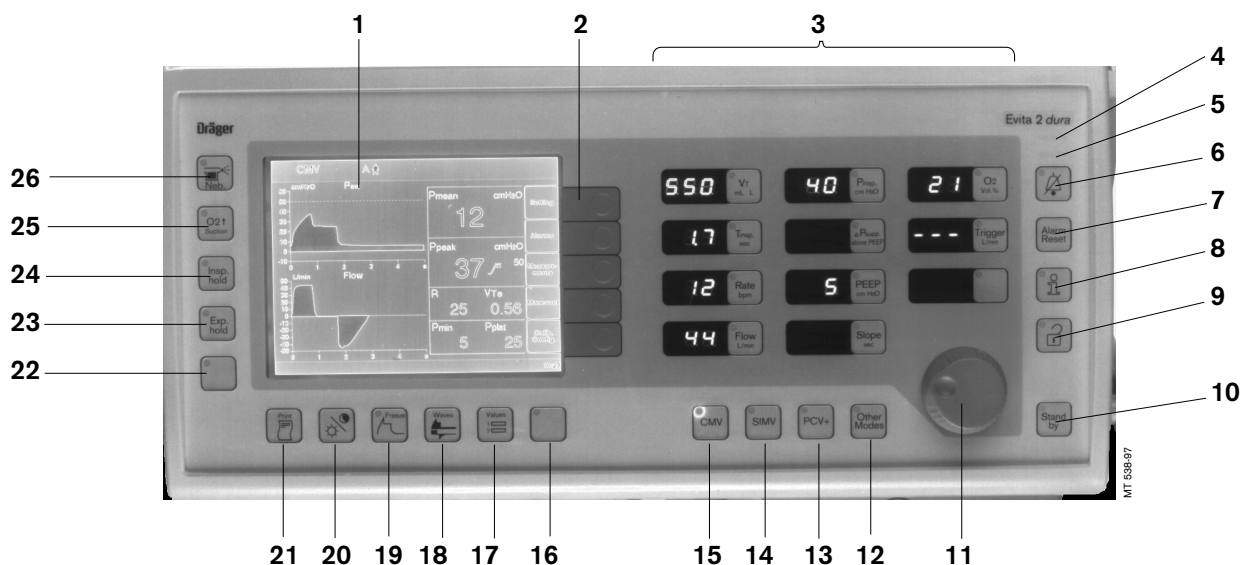
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







What's What

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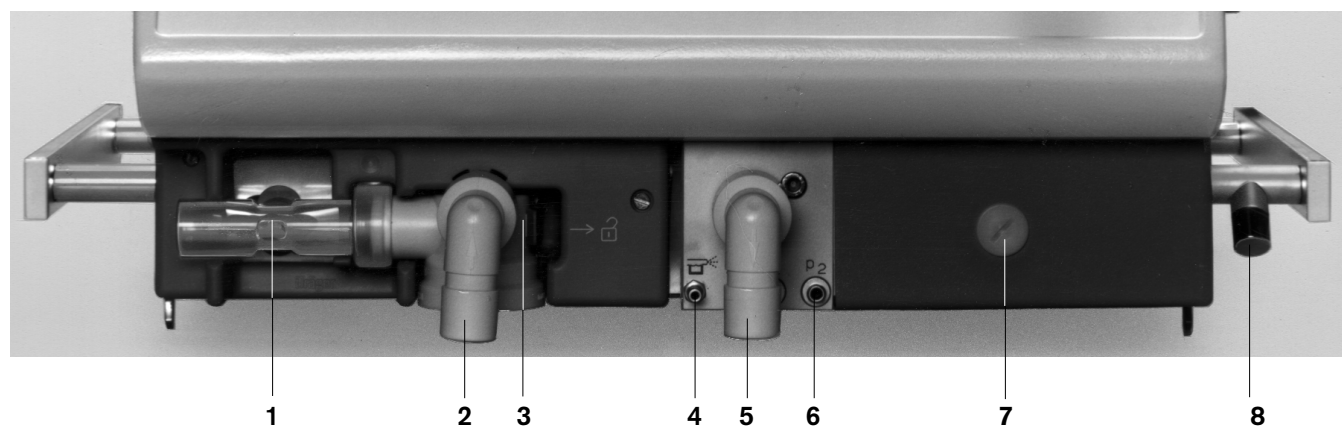
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Control Panel



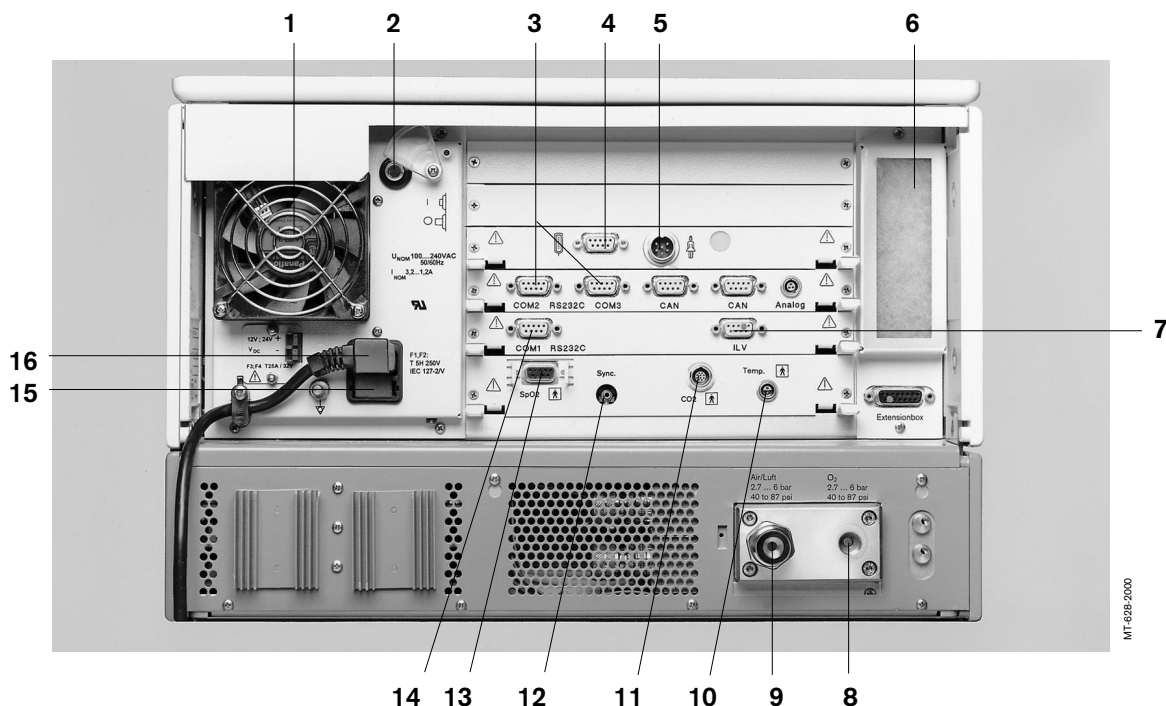
- | | | | |
|----|---|----|---|
| 1 | Screen for displaying application-specific screen pages | 13 | Key for PCV+ ventilation mode |
| 2 | Menu keys for displaying the application-specific screen pages | 14 | Key for SIMV ventilation mode |
| 3 | Parameter keys with numeric displays indicating settings – for adjusting ventilation parameters | 15 | Key for CMV ventilation mode |
| 4 | Red signal light for WARNING-level alarms | 16 | Key reserved for additional functions in the future |
| 5 | Yellow signal light for CAUTION- and advisory level alarms | 17 | »Values 1□ 2□« key for changing the displayed set of values |
| 6 | »  « key for silencing audible alarms for 2 minutes | 18 | »Waves  « key for changing the displayed pair of waveforms |
| 7 | »Alarm Reset« key for acknowledging alarm messages | 19 | »Freeze  « key for freezing waveforms |
| 8 | »  « key for calling up information and help on settings | 20 | »  « key for alternating screen backlighting between bright/dark |
| 9 | »  « key ("lock") for protecting the ventilation parameters and ventilation mode against unauthorized modification | 21 | »Printer  « key for manual printer logging |
| 10 | »Standby« key for switching between ventilation and standby modes | 22 | Key reserved for additional functions in the future |
| 11 | Central "turn and press" rotary dial knob for selecting and confirming settings | 23 | »Exp. hold« key for manual inspiration |
| 12 | »Other Modes« key for using additional ventilation modes programmed on-screen | 24 | »Insp. hold« key for manual inspiration |
| | | 25 | »O2 ↑ Suction« key for pre/post oxygenation program during bronchial suction |
| | | 26 | »  « key for switching pneumatic aerosol nebulizer on/off |






Front Connections



- 1 Flow sensor
- 2 Expiratory valve with expiratory port
- 3 Latch for expiratory valve
- 4 Gas supply port for pneumatic nebulizer
- 5 Inspiratory port
- 6 Connections for optional pressure measurement (not yet used)
- 7 Locking screw for protective cover (behind it: O₂ sensor and air intake filter)
- 8 Park bracket for Y-piece

Back Panel



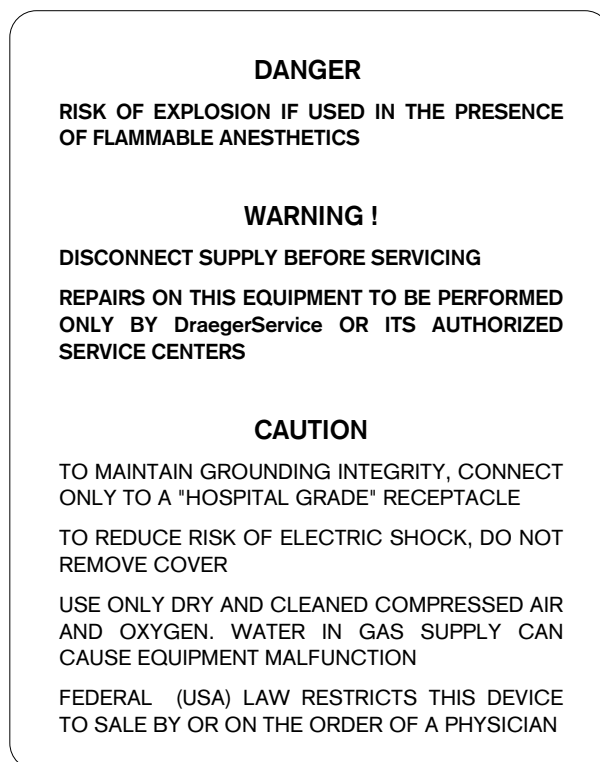
- | | |
|--|---|
| 1 Cooling fan | 13 Connector »SpO2  « for SpO2 measurement |
| 2 Power switch with protective cover | 14 Connector »COM1 RS232C« for RS 232 interface, e.g. printer |
| 3 Connectors »COM2«, »COM3« for RS 232 and analog interfaces (available option) | 15 Fuses |
| 4 Connection for »  « remote control pad (available option) | 16 Power cord connector |
| 5 Connection for »  « nurse call (available option) | |
| 6 Cooling air filter | |
| 7 ILV connector | |
| 8 DISS connection for supply of medical grade oxygen | |
| 9 DISS connection for supply of medical grade air | |
| 10 Temperature sensor socket »Temp  « | |
| 11 CO2 sensor socket »CO2  « | |
| 12 Connector for C-lock-ECG synchronization for optional SpO2 measurement | |

MT-228-2000

Labels

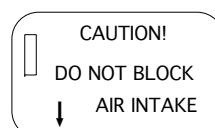
Main CAUTION/WARNING label

This label can be found on the left side of the ventilator.



Air Intake CAUTION label

This label can be found on the right front of the ventilator.

























Abbreviations and Symbols

Abbreviation	Definition
APRV	A irway P ressure R elease V entilation Spontaneous breathing at continuous positive airway pressure with short-term pressure release
bpm	breaths per minute
body Wt	Body weight (kg)
BTPS	B ody T emperature, P ressure. S aturated Measured values based on the condition in the patient's lungs, with body temperature 37 °C, water vapor-saturated gas, atmospheric pressure
C	Compliance
CMV	C ontinuous M andatory V entilation
CMVAssist	Trigger assisted C ontinuous M andatory V entilation
CPAP	C ontinuous P ositive A irway P ressure Breathing with continuous positive pressure in the airways
etCO ₂	End-expiratory CO ₂ concentration
FeCO ₂	Expiratory CO ₂ concentration
f	Breath rate
fapnea	Rate setting for apnea ventilation
fmand	Mandatory mechanical portion of overall breath rate
fspn	Spontaneous breathing portion of overall breath rate
Fail to cycle	Breathing cycle failure. Ventilator detects no inspiration (only in CMV)
FiO ₂	Inspiratory O ₂ concentration
Flow	Set value of the maximum inspiratory flow
FlowTrig	Set value of the flow trigger threshold
HME	H eat M oisture E xchanger
ILV	I ndependent L ung V entilation Ventilation with 2 ventilators, 1 for each lung
Int. PEEP	Intermittent Positive End-Expiratory Pressure = Sigh
IRV	I nverse R atio V entilation Ventilation with inversed inspiration/expiration ratio
ISO 5369	International standard for mechanical ventilators – "Lung Ventilation"
I:E	Ratio of Inspiration to Expiration
MMV	M andatory M inute V olume V entilation

Abbreviation	Definition
MV	Minute Volume
MV _{spn}	Spontaneous minute volume
MV _{Leak}	Leaking minute volume
NIF	Negative Inspiratory Force Maximum inspiratory effort
O ₂	Setpoint for inspiratory oxygen concentration [Vol. %]
P 0.1	Occlusion pressure at 100 ms
P _{supp.}	Set value of pressure support
P _{aw}	Airway pressure
PEEP	Positive End-Expiratory Pressure
PEEP _i	Intrinsic Positive End-Expiratory Pressure
P _{high}	Setpoint for upper pressure level APRV
P _{insp}	Setpoint for upper pressure level in PCV+
P _{low}	Setpoint for lower pressure level in APRV
P _{max}	Setpoint for pressure limited ventilation
P _{Mean}	Mean airway pressure
P _{peak}	Peak pressure
P _{Plat}	End-inspiratory airway pressure
PCV+ (BIPAP)	Pressure Controlled Ventilation Plus Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
PCV+ Assist	Pressure Controlled Ventilation Plus Assisted ventilation at continuous positive airway pressure with two different pressure levels
PLV	Pressure Limited Ventilation
P _{Supp.}	Pressure Support (set value of pressure support)
R	Resistance
RSB	Rapid Shallow Breathing Quotient of spontaneous breathing rate and tidal volume
SIMV	Synchronized Intermittent Mandatory Ventilation
T	Inspiratory breathing gas temperature
T _{apnea}	Alarm delay time for apnea
T _e	Expiratory time
T _{high}	Duration set for the upper pressure level in APRV
T _{insp}	Setpoint for inspiratory time
T _{low}	Duration set for the lower pressure level in APRV

Abbreviation	Definition
$\dot{V} \text{ CO}_2$	CO ₂ production [L/min] (optional)
V_{ds}	Serial dead space (optional)
V_T	Setpoint for tidal volume
V_{TApnea}	Setpoint for tidal volume of apnea ventilation
V_{Te}	Expiratory tidal volume
V_{Ti}	Inspiratory tidal volume
$V_{TP.S.}$	Inspiratory tidal volume during a pressure support breath
V_{trap}	Volume trapped in the lung by intrinsic PEEP and exhaled during subsequent expiration

Symbol	Definition
	Switch aerosol nebulizer on / off
	Switch oxygenation program for bronchial suction on / off
	Start manual inspiration
	Manually extend expiration
	Switch help function on / off
	Manual printer logging
	Bright / dark screen brightness setting
	"Freeze" waveforms on screen
	Select other combination of measured values
	Select other waveform(s)
	Silence audible alarm for 2 minutes
	Acknowledge alarms
	Protect (lock) ventilation parameters and ventilation mode
	Standby / Operation
	Lower / upper alarm limit
	Refer to Operating Instructions!
	Protection class Type B
	Protection class Type BF
	Insert flow sensor
	Unlock expiratory valve
	Evita Remote (remote control pad)
	Nurse call

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Technical Data

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Environmental Conditions

During operation

Temperature	10 to 40 °C (50 to 104 °F)
Atmospheric pressure	700 to 1060 hPa
Rel. humidity	0 to 90 %

During storage

Temperature	-20 to 60 °C (-4 to 140 °F)
Atmospheric pressure	500 to 1060 hPa
Rel. humidity	0 to 100 %

Settings

Ventilation Modes

CMV / CMVAssist
SIMV, SIMV / P_{Supp.}
MMV, MMV / P_{Supp.}
PCV+ / P_{Supp.}
PCV+Assist
CPAP / P_{Supp.}

Ventilator rate f

0 to 100 bpm

Inspiratory time T_{insp}

0.1 to 10 s

Tidal volume V_T

Pediatric range
Accuracy
0.02 to 0.3 L, BTPS*
±10 % of set value, or ±10 mL,
whichever is greater.

Adult range
Accuracy
0.1 to 2.0 L, BTPS*
±10 % of set value, or ±25 mL,
whichever is greater.

Inspiratory Flow

Pediatric range
Adult range
6 to 30 L/min
6 to 120 L/min

Inspiratory pressure P_{insp}

0 to 80 cmH₂O

Inspiratory pressure limit P_{max}

0 to 100 cmH₂O

O₂ concentration

Accuracy
21 to 100 Vol. %
±5 % of set value, or ±2 Vol. %,
whichever is greater.

Positive end-expiratory pressure PEEP or intermittent PEEP

0 to 35 cmH₂O

Trigger sensitivity

0.3 to 15 L/min

Pressure support P_{Supp.}

Rise time for pressure support (ramp)
0 to 80 cmH₂O
0 to 2 s

I:E ratio

1:9.5 to 4:1
(may be configured in start-up settings)

* BTPS = Body Temperature, Pressure, Saturated.
Measured values relating to the conditions in the patient lung,
body temperature 37 °C, water vapor saturated gas, ambient pressure.

Performance Data

Control principle	time-cycled, volume-constant
Intermittent PEEP rate	2 cycles every 3 minutes
Nebulization of aerosols	for 30 minutes
Bronchial suction	
Disconnection detection	automatic
Reconnection detection	automatic
Preoxygenation	max. 3 minutes
Active suction phase	max. 2 minutes
Postoxygenation	2 minutes
Valve response time T _{0...90}	≤ 5 ms
Demand flow system for spontaneous breathing and pressure support	adaptive CPAP system with high initial flow
max. flow rate	2 L/s in 8 ms
max. inspiratory flow	180 L/min
Ventilator compliance (with humidifier Fisher Paykel MR 730 and reusable silicone adult patient circuit)	≤ 2 mL/cmH ₂ O
Inspiratory Resistance	≤ 2.3 cmH ₂ O/L/s
Expiratory Resistance	≤ 3.8 cmH ₂ O/L/s
Equipment compliance (with humidifier Fisher & Paykel MR 730 and reusable silicone pediatric patient circuit)	≤ 1 mL/cmH ₂ O
Inspiratory Resistance	≤ 4.1 cmH ₂ O/L/s
Expiratory Resistance	≤ 4.1 cmH ₂ O/L/s
Additional functions	
Inspiratory relief valve	opens if gas supply fails (pressure < 1.2 bar, 17.4 psi), enables spontaneous breathing with filtered ambient air.
Safety relief valve	opens the breathing system at 100 cmH ₂ O.

Measured Value Displays**Airway pressure measurement**

Max. airway pressure	P _{peak}
Plateau pressure	P _{plat}
Pos. end-exp. pressure	PEEP
Mean airway pressure	P _{mean}
Min. airway pressure	P _{min}
Range	0 to 99 cmH ₂ O
Resolution	1 cmH ₂ O
Accuracy	±2 cmH ₂ O

O2 measurement in main flow (inspiratory side)

Inspiratory O2 concentration FiO2

Range	15 to 100 Vol. %
Resolution	1 Vol. %
Accuracy	±3 Vol. %

Flow measurement

Minute Volume MV

Spontaneously breathed minute volume MV_{spon}

Range	0 to 99 L/min, BTPS*
Resolution	0.1 L/min
Accuracy	±8 % of measured value
T 0...90	approx. 35 s

Tidal volume V_{Te}

Spontaneously breathed tidal volume V_{Tspon}

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Tidal volume V_{TP.S.}

Inspiratory tidal volume during a pressure support breath

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

Frequency measurement

Breathing rate f_{tot}

Spontaneous breathing rate f_{spon}

Range	0 to 150 bpm
Resolution	1 bpm
Accuracy	±1 bpm
T 0...90	approx. 35 s

Breathing gas temperature measurement (option)

Range	18 to 51 °C
Resolution	1 °C
Accuracy	±1 °C

* BTPS = Body Temperature, Pressure, Saturated.

Measured values relating to the conditions in the patient lung,
body temperature 37 °C, water vapor saturated gas, ambient pressure.

Computed value displays

Compliance C	
Range	0.7 to 200 mL/cmH ₂ O
Resolution	
range of 0.7 to 99.9 mL/cmH ₂ O	0.1 mL/cmH ₂ O
range of 100 to 200 mL/cmH ₂ O	1 mL/cmH ₂ O
Accuracy	±20 % of measured value ¹⁾
Resistance R	
Range	3 to 200 cmH ₂ O/L/s
Resolution	
range of 3 to 99.9 cmH ₂ O/L/s	0.1 cmH ₂ O/L/s
range of 100 to 200 cmH ₂ O/L/s	1 cmH ₂ O/L/s
Accuracy	±20 % of measured value ²⁾
Leakage minute volume MV _{Leak}	
Range	0 to 99 L/min, BTPS
Resolution	0.1 mL/min or 0.01 for values less than 0.1 L/min
Accuracy	±18 % of measured value
T 10...90	approximately 35 s

Waveform displays

Airway pressure P _{aw} (t)	-10 to 100 cmH ₂ O
Flow \dot{V} (t)	-150 to 180 L/min
Volume V (t)	0 to 2000 mL
Rapid Shallow Breathing index (RSB)	
Range	0 to 9999 ¹ /(min x L)
Resolution	¹ /(min x L)
Accuracy	see measurement of V _T and f
Negative Inspiratory Force NIF	
Range	-45 to 0 cmH ₂ O
Resolution	1 cmH ₂ O
Accuracy	± 2 cmH ₂ O



Monitoring

Expiratory minute volume MV	
Alarm at upper limit	if MV exceeds the upper alarm limit.
Setting range	41 to 0.5 L/min, in 0.1 L/min increments
Alarm at lower limit	if MV falls below the lower alarm limit.
Setting range	0.1 to 40 L/min, in 0.1 L/min increments
Airway pressure P _{aw}	
Alarm at upper limit	if the "P _{aw} high" threshold is exceeded.
Setting range	10 to 100 cmH ₂ O
Alarm at lower limit	if threshold "PEEP +5 cmH ₂ O" (linked to set value of PEEP) is not exceeded for at least 96 ms in 2 successive ventilator breaths.

-
- 1) Increased spontaneous breathing activity influences the compliance calculations; the accuracy of the measurement can therefore not be guaranteed in this case.
- 2) Increased spontaneous breathing activity influences the resistance calculations; the accuracy of the measurement can therefore not be guaranteed in this case.

Insp. O ₂ concentration FiO ₂	
Alarm at upper limit	if FiO ₂ exceeds the upper alarm limit for at least 20 seconds.
Alarm at lower limit	if FiO ₂ falls below the lower alarm limit for at least 20 seconds.
Range	both alarm limits are automatically linked to the setpoint – below 60 Vol. %: ± 4 Vol. % 60 Vol. % and over: ± 6 Vol. %
Insp. breathing gas temperature	
Alarm at upper limit	if temperature reaches 40 °C. (Evita 2 dura can also be used without temperature sensor if the sensor is not connected when switching on).
Tachypnea monitoring	
Alarm	during spontaneous breathing, if a preset spontaneous breathing rate has been exceeded.
Adjustment range	5 to 120 bpm
Volume monitoring	
Alarm at lower limit	if the set tidal volume V _T has not been supplied (alarm limit linked to setpoint of V _T).
Alarm at upper limit	if the applied tidal volume exceeds the alarm threshold, inspiration is interrupted and the expiratory valve is opened.
Adjustment range	30 to 4000 mL
Apnea alarm time	
Alarm	if no breathing activity is detected
Adjustment range	5 to 60 s, adjustable in 1 second increments.

Operating Data

Line power connection	100 V to 240 V 50/60 Hz
Current	
at 230 V	max. 1.3 A
at 100 V	max. 3.2 A
Power consumption	typically approx. 125 W
Ventilator fuses	
Range 100 V to 240 V	F 5 H 250 V IEC 127-2/V (2x)
Protection class	
Ventilator	Class I
CO ₂ sensor (with sensor connected)	Type BF 
Temperature sensor (with sensor connected)	Type BF 

Gas supply	
O ₂ gauge pressure	43.5 psi (3 bar) –10 % to 79.75 psi (5.5 bar) at 60 L/min (peak flow 200 L/min)
O ₂ connection thread	DISS, male (oxygen)
Air gauge pressure	43.5 psi (3 bar) –10 % to 79.75 psi (5.5 bar) at 60 L/min (peak flow 200 L/min)
Air connection thread	DISS, male (air) The gases must be dry and free from oil and dust (medical grade).
Gas consumption of control system	Medical grade Air or O ₂ approx. 3.5 L/min
Output for pneumatic nebulizer	Medical grade Medical grade Air or O ₂ max. 29 psi (2 bar), max. 10 L/min
Automatic gas switch-over	if one gas fails (supply pressure < 22 psi), the ventilator will switch to the other gas.
Sound pressure level (for free-field measurement over a reflecting surface)	max. 47 dB (A)
Dimensions (W x H x D)	
Main ventilator	530 x 290 x 450 mm (20.9" x 11.4" x 17.7")
Ventilator with mobile stand	580 x 1335 x 660 mm (22.8" x 52.6" x 26.0")
Weight	
Main ventilator	approx. 27 kg (60 lbs)
Ventilator with mobile stand incl. cabinet 8H	approx. 69 kg (152 lbs)

Ventilator Interfaces

Digital input/output	Output and input via an RS 232 C interface
COM 1	<p>LUST protocol Baud rates: 1200, 2400, 4800, 9600, 19200 Baud Data bits: 7 Parity: even Stop bits: 1</p> <p>MEDIBUS protocol Baud rates: 1200, 2400, 4800, 9600, 19200 Baud Data bits: 8 Parity: even, odd, none Stop bits: 1 or 2 (For the transmission of fast data, e.g. for the flow waveform, 19200 Baud are required)</p> <p>Printer protocol Hp DeskJet, 500 series Baud rates: 1200, 2400, 9600, 19200 Baud Data bits: 8 Parity: none Stop bits: 1 up to 15 m (45 foot)</p>
Cable length	up to 15 m (45 foot)
Load impedance	3000 to 7000 Ω

Signal voltage (for 3000 to 7000 Ω impedance)	
Low	between 3 and 15 V
High	between -3 and -15 V
Isolation protection	COM 1 terminal is galvanically isolated from the ventilator electronics. Test voltage for galvanic isolation is 1500 V.
Pin description	Pin 2 RxD Pin 3 TxD Pin 5 GND Connector housing Ventilator housing
Digital output	Output for independent lung ventilation (ILV)
Digital input/output (optional)	for output and input via two RS 232 C interfaces
Digital input/output (optional)	for output and input via a CAN interface
Analog output (optional)	for output of analog data

Performance Standards

Voluntary Performance Standards

The Evita 2 dura ventilator is designed to comply with ISO 5369 "International Standard for Medical Ventilation Equipment - Lung Ventilators" as well as ASTM F 1100 "Standard Specification for Ventilators for Use in Critical Care".

Electromagnetic compatibility EMC tested pursuant EN 60601-1-2
(according to EC directive 89/336)

Classification Class IIb
(according to EC directive 93/42, Appendix IX)

UMDNS Code 17-429
(Universal Medical Device Nomenclature System)

Materials Used

Part	Appearance	Material
Ventilation circuit (reusable)	milky, transparent	silicone rubber
Water traps	yellow, transparent	polysulphone
Y-piece with connector for temp. measurement	yellow, transparent	polysulphone
Expiratory valve housing, closure	milky, transparent	silicone rubber
	white	polyamide
Diaphragm	whitish and grey	silicone rubber and aluminum
CO ₂ cuvette	yellow, transparent	polysulphone with glass windows
Temperature sensor / cable	milky / green or blue	silicone rubber
CO ₂ sensor / cable	gray / gray	polyurethane

Theory of Operation

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Ventilation Modes

Volume-Controlled Ventilation with PLV

Classic volume constant mandatory ventilator breath

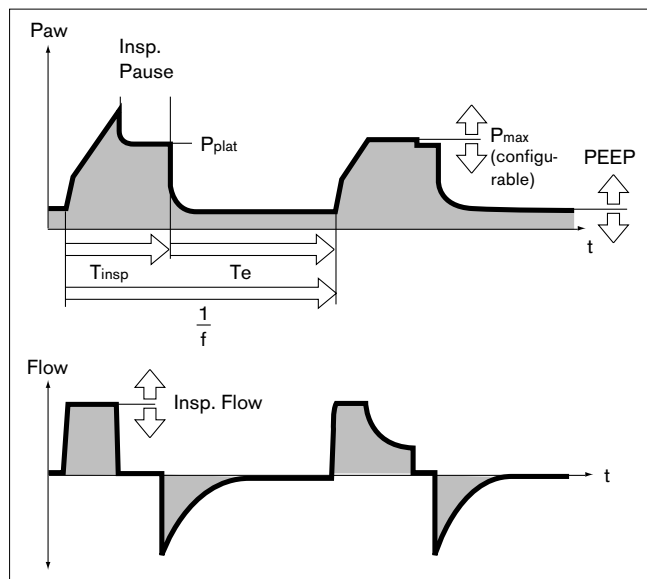
In mandatory ventilation modes, the parameter »Insp.Flow« restricts inspiratory flow. If the inspiratory flow is so high that the set tidal volume V_T is reached before inspiratory time T_{insp} is over, the inspiratory valve will close and the supply of breathing gas supply will stop. The expiratory valve remains closed until the end of the inspiration time T_{insp} . This phase, the inspiratory pause, can be identified in the P_{aw} (t) waveform as the plateau with a pressure P_{plat} .

Manual pressure limit P_{max}

Evita 2 dura can prevent pressure peaks while maintaining the set tidal volume V_T by setting a pressure limit P_{max} . The tidal volume V_T remains constant as long as a pressure plateau P_{plat} is still detectable in the pressure waveform and the flow curve shows a brief zero flow phase between inspiration and expiration.

Evita 2 dura performs this function by reducing the inspiratory flow upon reaching the set P_{max} value. If the set tidal volume V_T can no longer be filled with the selected pressure P_{max} due to reduced compliance, the alarm "Volume not constant" is automatically generated.

Manual pressure limiting can be performed with all ventilator models of the Evita family.



Sigh (Intermittent PEEP)

"Sigh" operates in the form of an intermittent PEEP in the ventilation modes CMV, CMV Assist and ILV.

The purpose of expiratory sigh during ventilation is to open collapsed areas of the lung, or to keep open "slow" areas of the lung.

Since atelectatic alveoli have a longer time constant – also caused by obstructed bronchioli – increased airway pressure maintained over a longer period is required to open them.

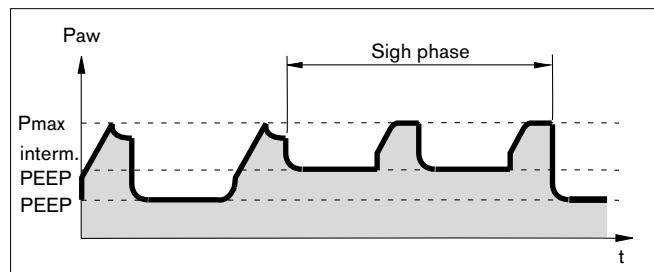
Commonly, a sigh breath is achieved by simply increasing the pressure level of a ventilator breath; however, due to the short time available, the filling of the »slow« alveoli is only marginally improved.

In the Evita 2 dura, the sigh operates during expiration with an intermittent PEEP.

Mean airway pressure is higher, and a longer filling time can be expected.

In order to avoid lung overinflation, pressure peaks during the sigh phase can be limited using pressure limit P_{max} without impairing the sigh function.

During the sigh phase, the "Volume not constant" alarm is disabled.



SIMV

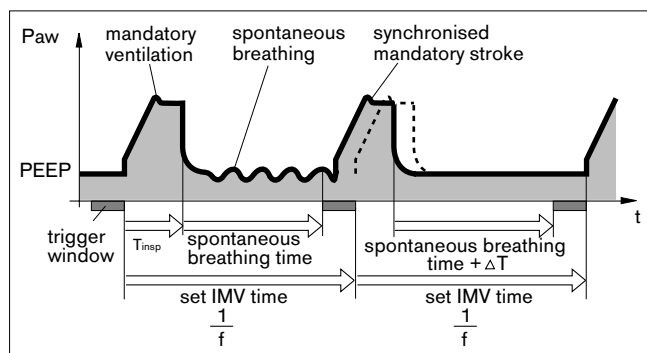
Synchronized Intermittent Mandatory Ventilation

Combination of ventilator breaths and spontaneous breathing.

SIMV enables the patient to breathe spontaneously during predefined, regular pause intervals, while mandatory mechanical breaths provide a minimum ventilation during the remaining cycles.

This minimum ventilation is controlled by setting two parameters: tidal volume (V_T) and ventilator rate (f). Minimum ventilation is the result of the product $V_T \times f$.

The ventilation pattern results from the set values V_T , Insp. Flow, breath rate f , and inspiratory time T_{insp} .



The flow trigger of the ventilator ensures that a ventilator breath is triggered in synchrony with a patient's spontaneous inspiratory effort within a "trigger window". This prevents mandatory ventilator breaths from being applied during spontaneous expiration.

The trigger window is 5 seconds long. If the expiratory time is less than 5 seconds, the trigger window covers the entire expiratory time.

Synchronization of mandatory ventilator breaths by itself effectively reduces SIMV time, which would result in an undesirable increase in the effective IMV rate.

Evita 2 dura therefore extends the subsequent time allowed for spontaneous breathing by the missing time difference ΔT – thus preventing an increase in SIMV rate. The mandatory breathing rate f , which is responsible for minimum ventilation together with tidal volume V_T , is kept constant.

If the inspiratory volume of the patient is considerable at the beginning of the trigger window, the ventilator reduces its subsequent mandatory ventilator breath by shortening the time for the inspiratory flow phase and overall inspiratory time. The tidal volume V_T remains constant, and overinflation of the lungs is avoided.

During the spontaneous breathing phases, the patient can be assisted with pressure using Pressure Support.

In the course of weaning, ventilator rate f can be progressively reduced which, in turn, will increase spontaneous breathing time, until finally the required total minute volume is supplied entirely by spontaneous breathing. Spontaneous breathing can be assisted by Pressure Support.

Pressure Support

Pressure support for insufficient spontaneous breathing.

The ventilator function for assisting insufficient spontaneous breathing is similar to that of an anesthetist manually assisting and monitoring a patient's spontaneous breathing by feeling the breathing bag.

The ventilator takes over part of inspiration, with the patient maintaining control of spontaneous breathing.

The CPAP system supplies the spontaneously breathing patient with breathing gas even during weak inspiratory efforts.

Pressure support is started:

- when the spontaneous inspiratory flow reaches the set value of the flow trigger, or, at the latest
- when the spontaneously inspired volume exceeds 25 mL (12 mL in pediatric mode).

The ventilator then produces an increase in pressure up to the preselected support pressure $P_{Supp.}$, which is adjustable to the breathing requirements of a patient.

The pressure rise time is adjustable from 50 milliseconds to 2 seconds.

With a rapid pressure rise

Evita 2 dura supports the insufficient spontaneous breathing of the patient with a high peak flow.

With a slow pressure rise

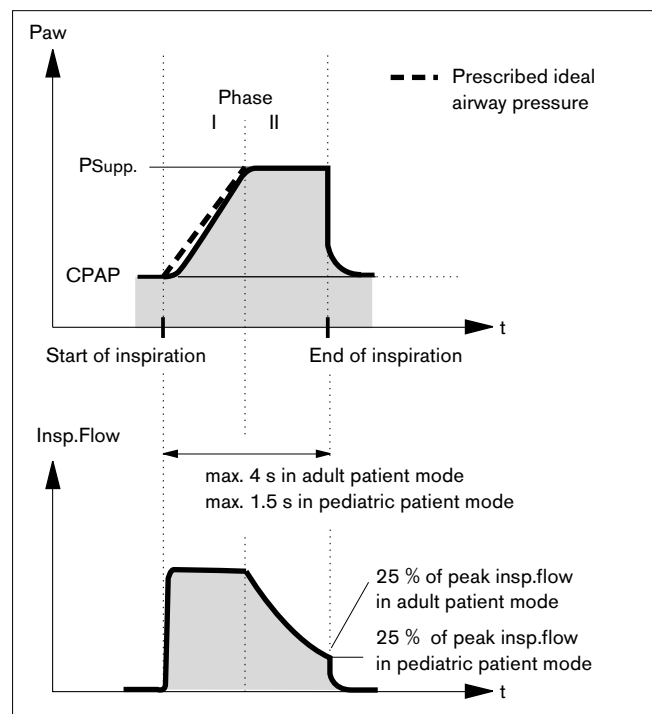
Evita 2 dura begins gently with regular inspiratory flow.

The patient has to contribute more to the breathing effort, and breathing muscle tone improves.

With the patient adjusted pressure rise and pressure support level, the patient's own breathing activity determines the required inspiratory flow, which can rise to 2 L/s in just 8 ms.

Pressure support is terminated:

- when the inspiratory flow returns to zero during phase I (see diagram on right), i.e. when the patient exhales or fights the ventilator, or
- when the inspiratory flow in phase II falls below a certain ratio when compared to the peak inspiratory flow previously supplied:
for adult ventilation: 25 % of inspiratory flow
for pediatric ventilation: 25 % of inspiratory flow, or
- at the latest after 4 seconds (1.5 seconds during pediatric ventilation) if the two other criteria have not triggered termination of the breath.
If this 4-second criterium is activated three times in succession, Evita 2 dura sounds an alarm and warns of a possible leak in the patient circuit.



PCV+

Pressure Support Ventilation Plus (intern.: BIPAP)*

The PCV+ ventilation mode is a pressure/time-cycled ventilation mode in which the patient can always breathe spontaneously. PCV+ is therefore often described as a time-cycled alternation between two CPAP levels.**

The time-cycled change of pressure provides controlled ventilation, which corresponds to pressure-controlled ventilation PCV. However, the continuously available opportunity of spontaneous breathing allows transition from controlled breathing to independent spontaneous breathing to take place smoothly during weaning, without requiring any change in the mode of ventilation. Both the change from expiratory to inspiratory pressure level, as well as the change from inspiratory to expiratory pressure level are patient synchronized for easy adaptation to a patient's spontaneous breathing pattern.

The rate of the pressure level changes is kept constant, even though synchronization occurs via a trigger time window with a fixed length.

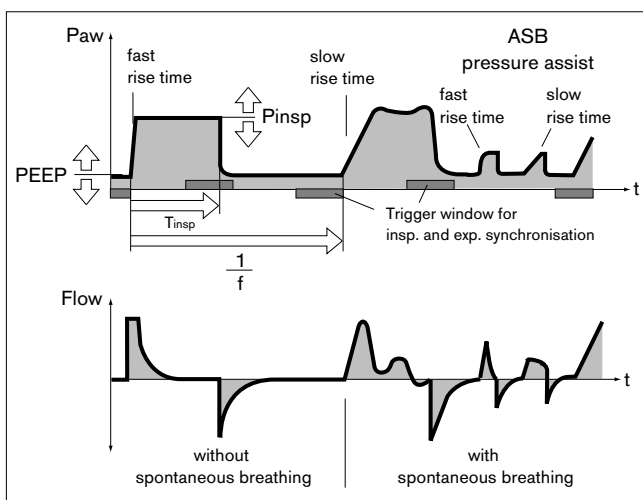
This smooth adaptation to the patient's spontaneous breathing requires less sedation, allowing the patient to return to spontaneous breathing more rapidly.

As in all pressure-controlled ventilation modes, the patient is not locked into a fixed tidal volume (V_T). The tidal volume essentially results from the pressure difference between settings for PEEP and P_{insp} .

The display of measured expiratory tidal volume V_{Te} must be used to set the required difference between the two pressure levels. Any increase in the pressure differential will cause an increased PCV+ ventilator breath.

Changes in lung compliance and airways, as well as active breathing by the patient, can lead to changes in tidal volume. This is a desired effect in this ventilation mode.

Knowing that tidal volume, and therefore minute volume, are not constant, the alarm limits for minute volume must be carefully adjusted.



* The registered trademark BIPAP is used under license.

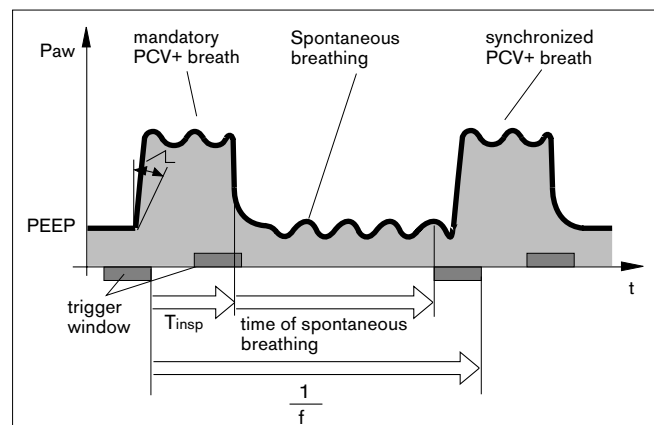
** References (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), page 130

Using PCV+

As with CMV, the time pattern is set using the basic setting parameters of ventilator rate f and inspiratory time T_i . The lower pressure level is set with the parameter PEEP, while the upper level is set with P_{insp} . When switching modes from CMV to PCV+, only the P_{insp} setting needs to be changed.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the »Slope« setting. The effective time for the increase in pressure cannot become greater than the set inspiratory time T_{insp} .

This precaution ensures that the upper pressure level P_{insp} is reached safely during inspiration. During weaning, the transition from controlled ventilation to fully spontaneous breathing is achieved by gradually reducing inspiratory pressure P_{insp} and/or rate f .



PCV+Assist (BIPAPAssist)

(Pressure Controlled Ventilation Plus, Assisted)

Pressure controlled, assisted ventilation

Inspiratory ventilator cycles are equivalent to those of PCV+, however, the switch from P_{insp} to PEEP is not synchronized with patient expiration.

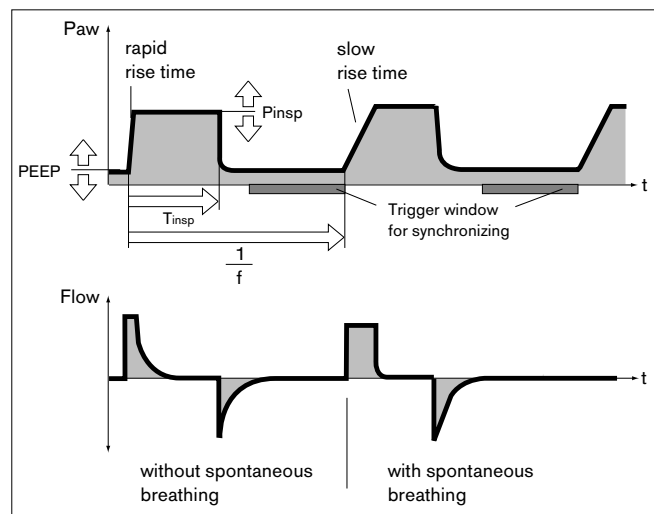
The duration of P_{insp} is determined by T_{insp} .

Spontaneous breathing is possible at any time during the inspiratory time.

Each recognized inspiratory effort by the patient will trigger a synchronized inspiratory cycle.

The ventilator will start a non-synchronized inspiratory cycle at the latest after the inspiratory time fixed by »f« and » T_{insp} « has elapsed.

Used for patients without spontaneous breathing all the way to patients with spontaneous breathing just before extubation.



MMV

Mandatory Minute Ventilation

In contrast to SIMV, the MMV ventilation mode provides mandatory breathing only if spontaneous breathing is not yet sufficient and has fallen below a preselected minimum minute ventilation.

This minimum ventilation is controlled by the two set values of tidal volume V_T and ventilator rate f as a result of the product $V_T \times f$.

Unlike SIMV, the mandatory breaths are not applied regularly but only during periods of insufficient ventilation.

The frequency of mandatory breaths is determined by the level of spontaneous breathing: if spontaneous breathing is sufficient, mandatory breaths are not used at all.

If spontaneous breathing is not sufficient, intermittent mandatory breaths of the set tidal volume V_T are applied. With no spontaneous breathing at all, the mandatory breaths are applied at the set rate f .

Evita 2 dura continuously balances the difference between spontaneous breathing and the set minimum ventilation.

As soon as the balance becomes negative due to insufficient spontaneous breathing, Evita 2 dura applies a mandatory ventilator breath at the set tidal volume V_T , so that the balance is again positive.

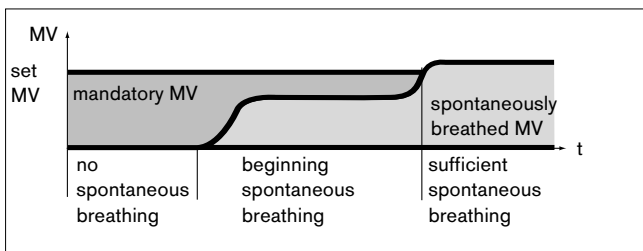
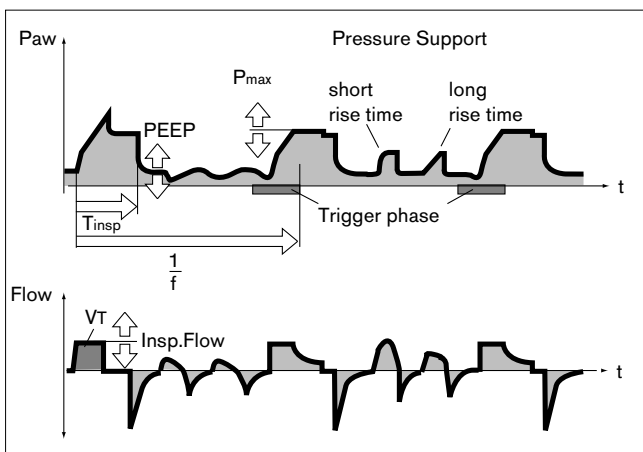
Experience shows that patients breathe very irregularly. Phases of weak breathing alternate with phases of strong breathing. In order to allow for these individual fluctuations, balancing minute ventilation also takes into account the extent by which the set minimum ventilation has been exceeded.

After an apnea, this positive balance is progressively reduced to zero by Evita 2 dura within a maximum of 7.5 seconds.

Hence, the response time of Evita 2 dura before activating mandatory ventilation is automatically adapted to the preceding cycles of spontaneous breathing:

If the level of this spontaneous breathing was close to the minimum ventilation, the ventilator responds rapidly within the IMV time. By contrast, if the patient's spontaneous breathing was much higher than the set minimum ventilation, Evita 2 dura tolerates a longer breathing pause. In the extreme case of a sudden apnea after a phase of heavy breathing, the response time will be 7.5 seconds plus the trigger time, with a minimum of 1 IMV cycle time (bpm).

Response times longer than 15 seconds may only occur if the minimum ventilation with a low IMV rate f is set to correspondingly low values.



In this case, Evita 2 dura triggers an apnea alarm that is cancelled again as soon as the mandatory ventilator breaths have been applied. If the IMV is set to a longer period than the alarm limit T_{Apnea} / \wedge , and if there is no spontaneous breathing between the mandatory ventilator breaths, the apnea alarm will be regularly triggered.

Example: $f = 3/\text{min} \cong \text{IMV time} = 20 \text{ seconds}$

$T_{Apnea} / \wedge \cong 15 \text{ seconds}$

This system is designed to prevent mandatory ventilation from being prematurely initiated in the event of irregular spontaneous breathing, while at the same time providing an alarm for any extended period of low ventilation.

Flow Measurement

Independent of whether ventilation is pressure or volume controlled, positive pressures are generated both in the patient circuit as well as in the patient's lung.

The volume delivered by the ventilator is distributed to both the patient lung and the circuit used between patient and ventilator. The distribution occurs according to the ratio of lung compliance versus patient circuit compliance.

Resulting expiratory deviations for the measured value of flow and the calculated values of minute ventilation and tidal volume are minimal when ventilating adults. This is due to the relatively large lung compliance compared to the compliance of the patient circuit.

Since only the volume actually entering and leaving the lungs is relevant for the efficiency of ventilation, and since larger deviations would be possible during pediatric ventilation, Evita 2 dura always compensates for the influence of patient circuit compliance.

Compensating for the effect of patient circuit compliance

During the ventilator check before the start of ventilation, Evita 2 dura determines the compliance of the patient circuit.

It then compensates the effect of this compliance on flow and volume measurement during ventilation.

Dependent on airway pressure, Evita 2 dura increases ventilatory volume in the same amount that will be remaining in the ventilation circuit.

Besides the influence of patient circuit compliance flow/volume measurement is affected by the physical parameters such as temperature and humidity as well as by leaks in the circuit system. Evita 2 dura takes these effects into account and corrects setpoints and measured values accordingly.

Recalculating for standardized gas conditions

The volume of a gas depends on the gas conditions temperature, pressure, and humidity.

For the purposes of lung physiology, reference is made to the conditions inside the lung for values of minute ventilation and tidal volume:

37 °C body temperature, pressure inside the lung,
100 % relative humidity.

Measured values for flow and volume under these conditions are characterized as BTPS*. Medical gases from cylinders or from a central supply are dry (approximately 0% relative humidity) and are delivered at 20 °C from the ventilator. Flow and volume measurements under these conditions are characterized as NTPD**. The difference between values measured as NTPD or BTPS is typically around 12 %.

Example: 500 mL tidal volume NTPD become 564 mL BTPS when warmed to 37 °C and humidified to 100 % relative humidity.

Evita 2 dura controls tidal volume in such a way that the set value of tidal volume is applied under BTPS conditions in the lung.

Automatic Leak Compensation

Evita 2 dura determines the difference between the flow delivered during inspiration and the flow measured during expiration.

This difference is a measure of the size of any leak and is displayed by Evita 2 dura as leakage minute volume MV_{Leak} .

During volume controlled ventilation, Evita 2 dura is able to compensate for the leak.

Example:

Set tidal volume $V_T = 500$ mL, 10% tube leak.

With leak compensation off

Evita 2 dura delivers 500 mL. The delivered value is displayed as 500 mL. 50 mL escape as leakage during inspiration, 450 mL enter the lung. 450 mL are also expired, of which 45 mL again will escape through the leakage. 405 mL are measured in the expiratory side and are displayed as V_{Te} .

* BTPS = Body Temperature, Pressure, Saturated.

** NTPD = Normal Temperature Pressure Dry.

As a result, an inspiratory minute volume of 5.0 L/min will be delivered at a breath rate of 10 bpm and an expiratory minute volume of 4.05 L/min will be measured. The lung is ventilated with an MV of 4.5 L/min.

Without leak compensation, the value set for V_T directly determines the amount of volume Evita 2 dura is going to deliver.

With leak compensation on

With its automatic leak compensation, Evita 2 dura will not deliver 500 mL tidal volume, but rather 555 mL based on the measured leak minute volume. 500 mL enter the lung and the inspiratory tidal volume V_{Ti} is also 500 mL.

This value is displayed as V_T .

Measured expiratory tidal volume is displayed uncompensated even when compensation is switched on and will therefore show 450 mL.

Expiratory measured minute volume is 4.5 L/min.

This value also remains intentionally uncompensated.

Otherwise, leak compensation might obscure a low minute volume alarm. Evita 2 dura is intended to generate an alarm in any case of low minute ventilation.

With leak compensation, the set value of V_T directly determines the amount of volume the patient is going to receive.

The example has been presented in a simplified fashion: calculation of leak compensation takes into account the pressures in the circuit system. The inspiratory loss of volume is a higher percentage than the expiratory loss since pressure is higher during inspiration. The leakage minute volume MV_{Leak} is referenced to mean pressure P_{mean} .

Leakage minute volume MV_{Leak} also takes into account inspiratory leaks. The sum of minute volume MV + leakage minute volume MV_{Leak} therefore exceeds the minute volume that is actually delivered to the patient during inspiration.

Unlimited volume compensation is not appropriate.

Evita 2 dura will compensate volume losses up to 100% of the set tidal volume V_T .

Due to technical tolerances small leakage minute volumes may be displayed even for a tight patient circuit.

Rapid Shallow Breathing Index RSB

The Rapid Shallow Breathing index (RSB)* is quotient of spontaneous breathing frequency (spontaneous breath per minute) and tidal volume.

$$\text{RSB} \left[\frac{1}{(\text{min} \times \text{L})} \right] = \frac{f_{\text{spont}} \left[\frac{1}{\text{min}} \right]}{\text{VT} \left[\text{L} \right]}$$

The smaller the RSB index for a spontaneously breathing patient, the higher the probability for successful weaning. The predictive power of the RSB index is tied to the fact that patients that can be successfully weaned have a tendency to show rather lower spontaneous breath rates and higher tidal volumes than patients not ready for weaning.

Yang and Tobin were able to show in a 1991 study* that the RSB index is a good predictor for the success of a weaning attempt. Patients with a RSB index $< 100 \frac{1}{(\text{min} \times \text{L})}$ were weaned with a probability of 80%.

On the other hand, 95% of patients with a RSB index of > 100 were not ready for weaning.

Evita 2 dura shows the RSB index in CPAP/P.Supp.

Negative Inspiratory Force NIF

The Negative Inspiratory Force index (NIF)** measures the maximum inspiratory effort of a patient after a preceding expiration. The patient system is closed during the measurement of NIF. The NIF value is also called Maximum Inspiratory Pressure (MIP).

During a manually extended expiration, the patient generates a negative pressure relative to PEEP. The stronger this negative pressure, the more likely a successful extubation is going to be. Patients reaching a NIF

$< -30 \text{ cmH}_2\text{O}$ can be successfully extubated with a high probability, whereas extubation for patients who reach only a NIF down to $-20 \text{ cmH}_2\text{O}$ is very likely to fail.

Evita 2 dura determines the value of the NIF index during a manually extended expiration. While the »Exp. hold« key is pressed, the patient system is closed after an expiration and Evita measures the maximum inspiratory patient effort. The value of NIF is measured as a pressure relative to PEEP. Releasing the »Exp. hold« key after a maximum of 15 seconds completes the measurement maneuver. The ventilator shows the last NIF value measured and the time of measurement in its table 2 of measured values.

* Reference (8), see page 156

** Reference (9), (10) see page 156

Inspiratory O₂ Concentration During Nebulizing of Aerosols

The integrated nebulizer function of Evita 2 dura is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause deviations in tidal volume and inspiratory O₂ concentration!

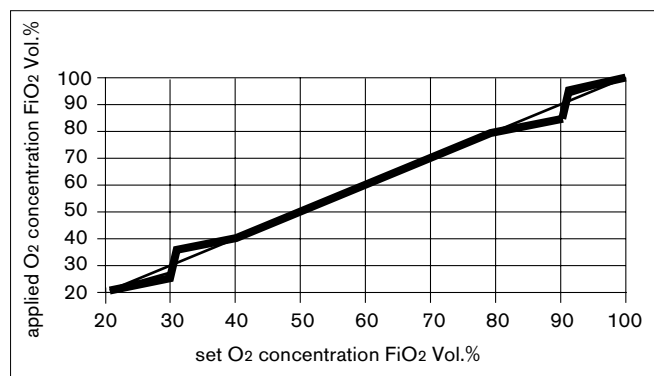
In order to minimize the deviation from the set O₂ concentration, Evita 2 dura produces a mixed gas to drive the nebulizer.

In the adult mode this mixed gas is generated by switching between the supply gases (medical grade air and oxygen) in synchrony with inspiration.

In pediatric mode, where nebulizing is not synchronized with inspiration, the deviation from the set O₂ concentration is calculated every 5 seconds and it is switched between the supply gases accordingly.

The driver gas of the nebulizer therefore roughly corresponds to the set FiO₂.

The graph shows the possible deviations of the applied O₂ concentration as a function of the set FiO₂ at the lowest inspiratory flow (15 L/min) in adult mode and for respiration rates greater than 12 bpm in pediatric mode.



References

- (1) Baum, M., Benzer, H., Putensen, Ch., Koller, W., Putz, G.:
Biphasic Positive Airway Pressure (BIPAP) – eine neue Form der augmentierenden Beatmung
Anaesthesist 38 (1989), 452-458
- (2) Luger, Th.J., Putensen, Ch., Baum, M., Schreithofer, D., Morawetz, R.F., Schlager, A.:
Entwöhnung eines Asthmatikers mit Biphasic Positive Airway Pressure (BIPAP) unter kontinuierlicher Sufentanil Gabe
Anaesthesist (1990) 39: 557-560
- (3) Hensel, I.:
Atemnotsyndrom nach Beinahe-Ertrinken
Rettung durch neuartiges Beatmungsprogramm?
Rettungsdienst 11 (Nov. 1991), 737-739
- (4) Meyer, J.:
Neue Beatmungsformen
Anästhesiol. Intensivmed. Notfallmed. Schmerzther. 26 (1991) 337 - 342
- (5) Vincent, J.-L.:
Yearbook of Intensive Care and Emergency Medicine
Springer-Verlag 1993
- (6) E. Voigt:
BIPAP Anwendungshinweise und Kasuistik.
Dräger-Mitteilungen "Medizintechnik aktuell" 1/94
- (7) E. Bahns:
BIPAP – Zwei Schritte nach vorn in der Beatmung
Dräger Fibel zur Evita Beatmung
- (8) Yang, K.L.; Tobin, M.J.:
A Prospective Study of Indexes Prediction the Outcome Of Trials of Weaning from Mechanical Ventilation
The New England Journal of Medicine, 1991, 324, S. 1445-1450
- (9) Tobin, Jubran, A.:
Advances in Respirators Monitoring During Mechanical Ventilation
CHEST 1999, 116, S. 1416-1425
- (10) Tobin, M.J., Charles, G.A.:
Discontinuation of Mechanical Ventilation
in: Tobin, M.J. Principles and Practice of Mechanical Ventilation, 1994, S. 1177-1206

Ordering Information

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Name/Description	Order No.	Name/Description	Order No.
Basic ventilator unit		CapnoPlus	84 13 780
Evita 2 dura	84 11 800	Evita 4 Link	84 11 735
Accessories required for operation		Evita 4 Sat	84 13 035
Hinged circuit support arm	84 09 609	Evita 4 DC	84 13 034
or		NeoFlow	84 13 563
Quick-stop support arm 2	2M 85 706	ATC	84 14 556
Air supply filter and water trap, straight	84 14 453	Colour Plus	84 11 888
Air supply filter kit	84 14 703	Nurse call	84 14 476
O ₂ supply filter and water trap, straight	84 14 452	Plug for connecting the nurse call	18 46 248
O ₂ supply filter kit	84 14 702	EvitaRemote	84 14 472
For mounting humidifier		Mask Ventilation (NIV)	84 14 474
Mounting brackets		Software 4.0 plus Evita 2 dura	84 14 470
(for Fisher Paykel MR 730)	84 11 074		
Special accessories		For CO₂ measurement (option)	
Instrument tray Evita 2 dura	84 11 621	CO ₂ -Cuvette, adult	68 70 279
Pneumatic aerosol nebulizer	84 12 935	CO ₂ -Cuvette, pediatric	68 70 280
Adult test lung	84 03 201	CO ₂ main flow sensor	68 70 300
Mobile cart:		Holder for "parking" CO ₂ sensor	84 12 840
"EvitaMobil" trolley (high)	84 14 455	Test filter	68 70 281
with column extension, 50 mm		Calibration kit	84 12 710
For mobile cart:		Test gas cylinder CO ₂	82 90 271
Set cylinder bracket EvitaMobile	84 11 970	Exchange parts for disinfection	
Battery 12V/17A	18 43 303	Expiratory valve (patient block)	84 10 580
Cabinet 4H (2 drawers)	M 31 795	For ventilating adults:	
Cabinet 8H, 360 mm (14.2") high	M 31 796	Patient circuit, adult (for use with	
Cabinet mounting kit	84 09 018	Fisher & Paykel humidifier)	84 12 108
alternatively, to be installed		Patient circuit, paediatric (F&P)	84 12 081
in mobile cart:		Hose set HME	84 12 860
Air compressor	84 13 890		
MEDIBUS cable	83 06 488	Replacement parts	
Printer cable	83 06 489	For Evita 2 dura:	
ILV cable Evita 4/Evita 2 dura	84 11 794	O ₂ sensor capsule	68 50 645
VentView 1.n (incl. Medibus cable)	84 14 095	Flow sensor (set of 5)	84 03 735
Flowsensor Cover	84 14 714	Cooling-air filter blue	84 12 384
Options/Kits for retrofitting on site		Lithium battery for data protection	18 35 343
Ventilation Plus	84 13 540	For circuit support arm:	
Monitoring Plus	84 13 545	Circuit holder	84 09 746
Service Plus	84 13 550	Hose clamp	84 09 841

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These Operating Instructions apply only
to **Evita 2 dura**
with Serial No.:

If no Serial No. has been filled in by
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provided for general information only and
are not intended for use with any specific
machine or device.

If Serial No. ARxx-xxx:

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